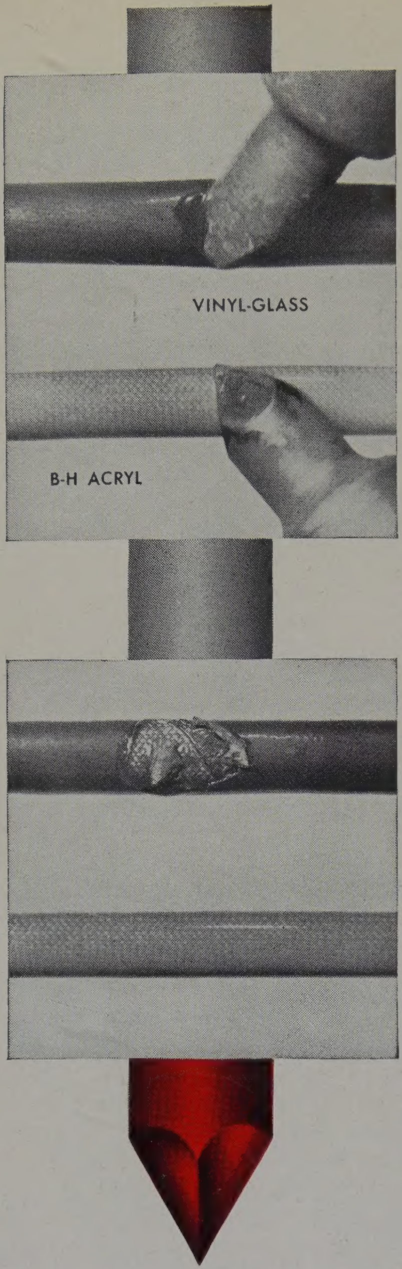
September 1961

Insulation

Varnish heat stability . . . page 17

In this issue: *Reliability . . . page 4*
Epoxy case histories . . . page 29
More on water-soluble fluxes . . . page 33
Metric system . . . page 40
Silicone rubber after 9000°F . . . page 85



HIGH TEMPERATURE SOLDERING

CANNOT DAMAGE . . .

BH ACRYL

ACRYLIC COATED FIBERGLASS SLEEVING

- THERMOSETTING — CANNOT FLOW
- UNLIMITED WIRE ENAMEL COMPATIBILITY
- EXTENDED HEAT LIFE (10,000 HOURS @ 155°C)
- EXCELLENT FLEXIBILITY
- LOW COST

With the new Bentley-Harris Acrylic Sleevings, damage during soldering, dip and bake cycles becomes a thing of the past. BH Acryl-A and BH Acryl-C are fiberglass sleevings coated with a heat-resistant acrylic resin. They are compatible with all wire enamels and as flexible as vinyl-glass, while offering extended heat life . . . up to 50,000 hours at 130°C. Both BH Acryl-A and BH Acryl-C mean Class B protection at Class A cost. Send for data sheet and testing samples today.

BENTLEY-HARRIS
MANUFACTURING COMPANY

CONSHOHOCKEN 6 • 900 BARCLAY STREET PENNSYLVANIA

Print Ins. 1 on Reader Service Card

Print Ins. 2 on Reader Service C

3M COMPANY

CASE

RUSCO
Engineered Fabrics since 1834

GLASTIC

CDF

BRADY

B
PRE
O

IRVINGTON
DIVISION
3M

DOW CORNING
SILICONES

K&M
best in asbestos

Varflex
CORPORATION

MICO
ELECTRICAL INSULATION

OWENS CORNING
FIBERGLAS

Air Fixtures, Inc. — tape dispensers ● Anaconda Wire & Cable Co. — magnet wires ● W. H. Brady Co. — adhesive wire markers, masks, labels ● Case Brothers, Inc. — papers ● Continental-Diamond Fibre Corp. — fibre ● Dow Corning Corp. — silicone varnishes, compounds, rubbers ● Eggers Plywood Co. — maple wedges ● Glastic Corp. — glass polyester insulation ● Irvington Div., Minnesota Mining and Manufacturing Co. — tubings and sleevings; coated or varnished cloth, tapes, and paper; "Mylar" film combinations; polyester mat and web; varnishes and compounds, vinyl tapes ● Keasbey & Mattison Co. — asbestos tapes, tubings, cords ● Lambeth Rope Corp. — cotton tape ● Lenni Products, Inc. — fishpaper wedges, cuffed insulation ● Mica Insulator Div., Minnesota Mining and Manufacturing Co. — laminated plastics; mica plates and combinations; reconstituted mica; copper clads ● Minnesota Mining and Manufacturing Co. — pressure-sensitive tapes; tape dispensers; resins ● Owens-Corning Fiberglas Corp. — glass cords ● Rogers Corp. — papers ● Russell Manufacturing Co. — glass tape ● Varflex Corp. — varnished sleevings, silicone tying cord ● Wilmington Fibre Specialty Co. — fibre parts. ●

KNOWN BY THE COMPANY WE KEEP

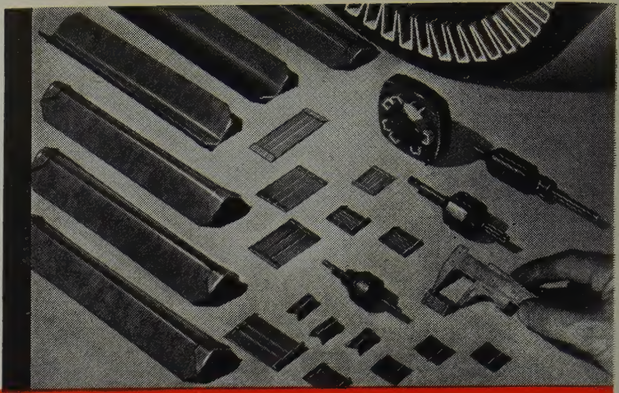
To some extent, every distributor is known by the insulation manufacturers it represents. Their stature and quality reputation directly reflect on the customer service performance of the distributor. It is natural that some of the aura of leadership which characterizes the top insulation manufacturers should rub off on Prehler, their distributor. And Prehler is equally proud that it has earned a position of leadership on its own record through fair and intelligent representation of the best insulation manufacturers to the best insulation customers. Prehler offers you a complete variety of nearly all insulation materials, convenient warehouse stocks, expert insulation material and application know-how, and a genuine desire to be of service. Ask for more information, today.

B
PRE
O

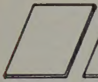
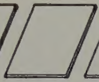
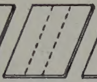
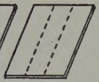
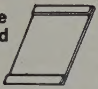
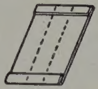
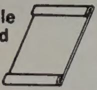
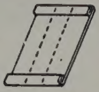
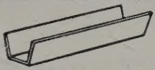
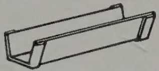
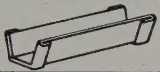
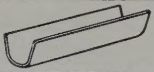
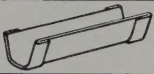
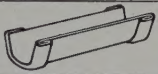
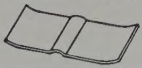
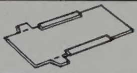
PREHLER ELECTRICAL INSULATION CO.

Chicago 39, Ill., 2300 N. Kilbourn Ave., EVerglade 4-6100
Branch Offices
Cleveland 30, Ohio, 12200 Brookpark Rd., CLearwater 1-1800
Detroit 2, Mich., 411 Piquette Ave., TRinity 5-4020
St. Paul 1, Minn., 367 Grove St., CApital 5-4321
Milwaukee 12, Wis., 3379 N. Green Bay Ave., FRanklin 4-3100
Dayton, Ohio, BAldwin 2-0574
(Use Cleveland Address)

Uniform...Accurate ...Ready to Insert Inmanco® Fabricated Slot Insulators



SELECT YOUR REQUIREMENTS FROM THIS CHART OF SLOT INSULATORS MADE TO YOUR DIMENSIONS

SLOT INSULATOR STYLE (Paper grain runs parallel to width except in 110X, 120X, and 140XR)	MATERIAL			MATERIAL				
	ALL-RAG PAPERS	TAN ELECTRICAL KRAFT PAPERS	MYLAR OR ACETATE-PAPER COMB.	PAPER-VARNISHED CAMBRIC COMB.	FIBRE OR FISH-PAPER	MYLAR FILM	TEFLON FILM	MYLAR DACRON COMBINATION
 Plain Flat (110)  Plain Flat (110X)  Scored Flat (120)  Scored Flat (120X)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Single Cuffed Flat (210)  Scored Single Cuffed Flat (220) 	.025" max	Yes	Yes	Yes	No	Yes	No	Yes
Double Cuffed Flat (310)  Scored Double Cuffed Flat (320) 	.010" max	.010" max	.010" max	No	No	Yes	No	.011" max
Plain Flat Bottom (130) 	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Single Cuffed Flat Bottom (230) 	.025" max	Yes	Yes	Yes	No	Yes	No	Yes
Double Cuffed Flat Bottom (330) 	.010" max	.010" max	.010" max	No	No	Yes	No	.011" max
Plain Round Bottom (140) 	Yes	Yes	No	Yes	Yes	No	No	No
Single Cuffed Round Bottom (240) 	.025" max	Yes	No	Yes	No	No	No	No
Double Cuffed Round Bottom (340) 	.010" max	.010" max	No	No	No	No	No	No
Contour (140XR) 	Yes	No	Limited	No	No	No	No	No
Tab and Cuffed Shaded Pole (220TS) 	Yes	No	Limited	No	No	Limited	No	No
Available Thicknesses, Inches	.005", .007", .010", .015", .020", .025", .031", .0625"	.005", .007", .010", .015", .020"	.006" through .021"	.010" through .028"	.004" to ⅛"	.00025" through .010"	.002" through .060"	.008" .009" .011"

IN ADDITION TO THE DESIGNS SHOWN ABOVE, MANY VARIATIONS AND SPECIALS ARE AVAILABLE.
CONTACT YOUR *INMANCO REPRESENTATIVE FOR DETAILS.*

"Mylar®",
"Teflon®",
and "Dacron®"
are DuPont
trademarks

Made by
Inmanco®
DIVISION

INSULATION MANUFACTURERS CORPORATION
565 West Washington Boulevard, Chicago 6, Illinois
Branch Offices, Representatives, and Distributors in Principal Cities

Print Ins. 3 on Reader Service Card

Insulation

For the Electrical and Electronic Industries

Lake Publishing Corporation, 311 East Park Avenue, Libertyville, Illinois, September, 1961
Publishers of Insulation, Insulation Directory/Encyclopedia Issue, Plastics Design & Processing

17 *Thermal Stability of Class F Insulating Varnishes*
C. J. Straka

29 *Case Histories Point Up High Strength, Heat Resistance, and Electrical Properties of Epoxies*
H. B. Heinzen

33 *An Evaluation of Water-Soluble Fluxes—Part 2*
F. Z. Keister

42 *Glass Microminiature Transistor Enclosure*

42 *Longer Overhead Transmission Cable in Large Sizes*

84 *Synthetic Rubber for A-C Connectors in Mine*

85 *Silicone Rubber After 9000°F*

4 *From the Editor*

6 *News and Views*

8 *Pixilated Patents*

12 *Insulation Forum*

40 *Letters to the Editor*

44 *People in the News*

46 *Association News*

48 *Industry News*

52 *European Insulation Report*

60 *New Publications*

62 *New Materials and Components*

86 *New Instruments and Equipment*

91 *New Literature*

94 *Dates to Circle*

95 *NEMA Electrical Insulation Index*

96 *Advertisers' Index*

Editor and Publisher: Lincoln R. Samelson
Associate Editor: Richard D. Simonson
Production Manager: F. P. Mignin
Contributing Editors: Graham Lee Moses, H. K. Graves, Mike Rivise
Consulting Editor: George V. Michael
Art Director: Randall R. Roth
Circulation Policy and Subscriptions: Insulation is distributed without charge within the United States to qualified users of electrical and electronic insulating materials engaged in design and specifying work covering the use of insulation. Subscription rates to others within the United States, Canada, and U.S. Possessions are $1.25 per copy, $12.50 per year, and $20.00 for two years. Rates for other countries are $25.00 per year, $45.00 for two years. Circulation requests and inquiries should give title or department, company name, and products or services of company. Corrections should also show old company name and address.
Back Issues, when available, are charged for at the rate of $1.50 per copy for 1 to 10 copies and $1.25 per copy for 10 or more copies for requests from within the United States, Canada, and U.S. Possessions; $2.50 per copy to all other countries.

Copyright, 1961, by Lake Publishing Corp. Reproduction of text and illustrations not permitted without permission of copyright owners.
Opinions expressed in this publication by authors are not necessarily those of the publishers and this publication can accept no responsibility in connection with any liability which might develop as a result of articles published.

Insulation, September, 1961, Volume 7, Number 10. Published monthly, except twice a month in May, by Lake Publishing Corp., Box 270, 311 E. Park Ave., Libertyville, Ill. Phone EMpire 2-8711. Accepted as controlled circulation publication at Mount Morris, Illinois.

BPA Member Business Publications Audit of Circulation, Inc.

Advertising Sales Offices: See page 96.

From the Editor

Opinions and Rambling Thoughts

Reliability—Much To Be Done

Over the past few years there has been a great deal of encouraging progress in the area of reliability of electrical/electronic products. However, much remains to be done.

One aspect that needs greater effort is an improvement in the understanding of reliability on the part of both consumers and industry. Too many people not directly concerned with reliability programs still think that reliability and infinite life should be synonymous—they must be educated to understand that reliability is an expression which must always be clarified in terms of prescribed life periods, operating and storage conditions, environment, etc. In other words, an electronic assembly which lasts only 30 minutes in a missile is is just as reliable as a washing machine motor which lasts 20 years, providing both were designed for such life. From the number of complaints we hear, it is obvious that many people still do not recognize the true meaning of reliability.

Today, the word *quality* has become rather meaningless because it has been used so indiscriminately without supporting evidence. At negligible extra cost, industry could undertake a massive public relations program to educate everyone as to the real meaning of reliability if, in all advertising and promotional activities, the word *quality* were replaced with an expression relating to *reliability* and what reliability means as applied to the specific product being promoted. For example, television manufacturers might state that reliability is designed into their products—that they are built to operate for X number of years based on X number of viewing hours per week without malfunctioning of any components (excepting tubes).

Public relations effort is also needed to counter the widely-held opinion that electrical/electronic and other products are not as reliable as they used to be. In nearly all cases, study after study reveals that products today are more trouble-free than they were years ago. This is especially true with equivalent products but it is also true with the products which are infinitely more complex than their counterparts of years ago. Appliances, cars, motors, radios . . . you name it . . . are generally more reliable, based on usage, than they used to be. And in spite of inflation, some of these products are offering more value per dollar than ever before.

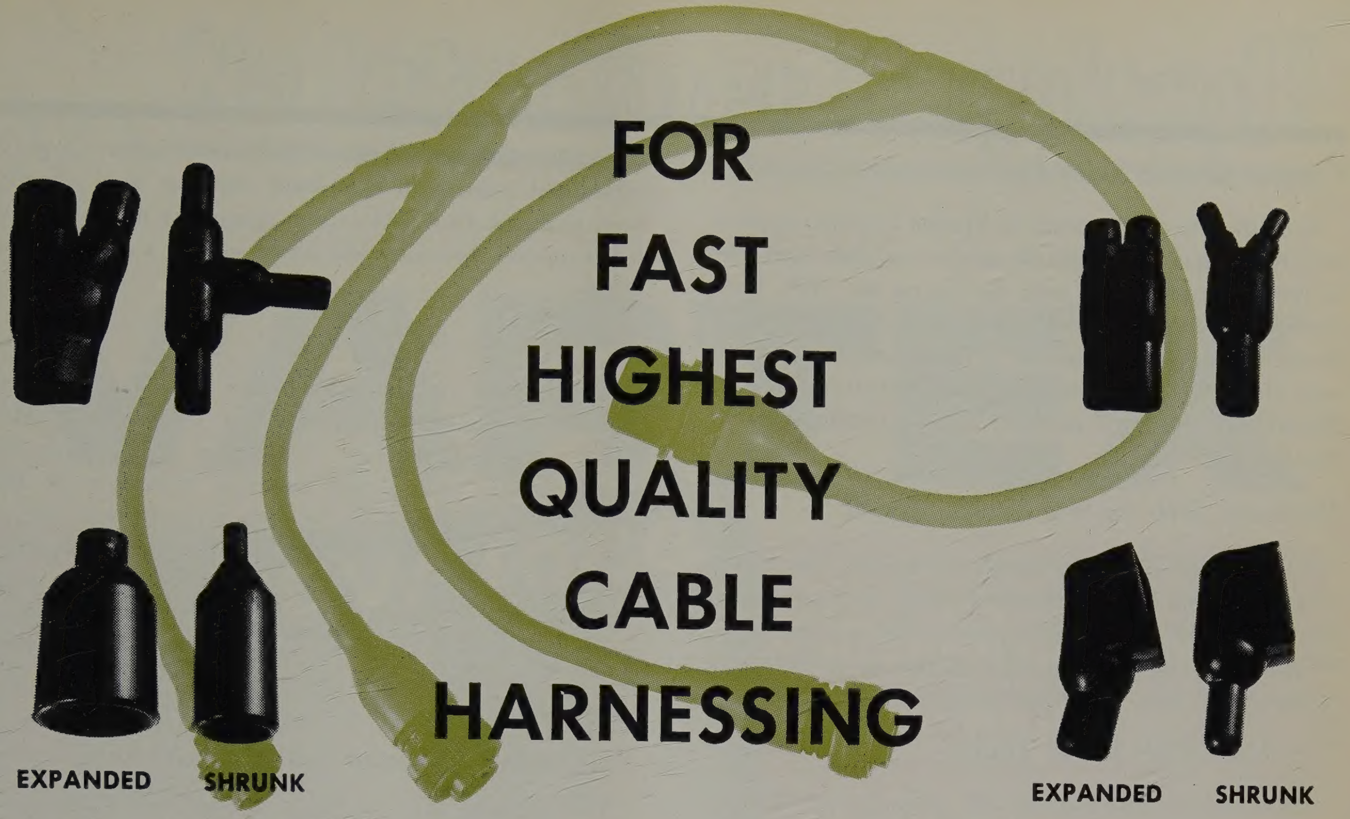
Another aspect of reliability that requires discussion is the need for more and better reliability standards and measurements. In many cases these can actually take the form of written guarantees. In other cases they cannot. Present industry, commercial, and government standards and specifications can often serve as the basis for reliability standards and measurements—it is just a matter of going one step further. Classes of reliability could be developed in accordance with the needs of the users of different types of products. Limitations on the variables which determine reliability could be defined for each reliability class. Accepted methods (which in most cases are already established) could be used in developing these definitions and in determining reliability classes for particular products.

Some electrical/electronic products are already manufactured to standards which really could be called reliability standards. The trade or technical societies responsible can be proud of this accomplishment. Every manufacturer should encourage such work and cooperate to make sure that, eventually, all suitable products are covered. And it should not be overlooked that it is the responsibility of the manufacturers to interpret reliability standards and definitions in such a way that the buyers of their products readily understand *and use* them.

Of course, another point for consideration is the need for more research in regard to investigating reliability variables. Justifiably, industry should bear much of the burden for this research but the government, as the largest buyer, can certainly help lead the way and lend coordination to such research.

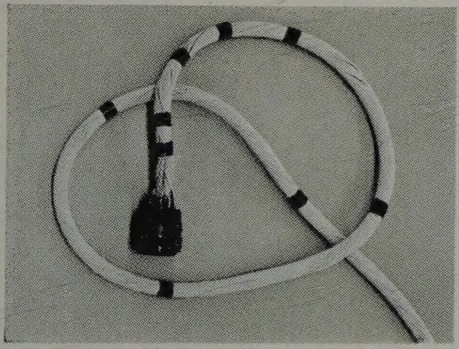
Our Tax Plan

We read so much about the need to change our tax laws to close loopholes, spur business growth, subsidize certain groups and interests, and promote the welfare of indigent poodles in Northern Alaska that we are just plain fed up. We have a two-part tax plan of our own which would revolutionize and simplify the whole tax system and make a lot of taxpayers happy. No. 1—cut down and eliminate needless, wasteful, and special interest spending—we don't need all the services a benevolent Uncle Sam is providing. No. 2—eliminate all exemptions so that everyone who makes the same amount of money pays the same tax—this would eliminate 90% of the tax collection work and would remove the unfairness of penalizing a man because he chooses to remain a bachelor, or is not over 65, or is not blind, etc., etc., etc.



FOR FAST HIGHEST QUALITY CABLE HARNESSING

THERMOFIT®


THE CABLE

SLIP THE BOOT ON

HEAT—IT SHRINKS

RAYCLAD TUBES
INCORPORATED

A SUBSIDIARY OF
RAYCHEM
CORPORATION

Premolded harness encapsulating boots and transitions which, when subjected to the brief application of heat, shrink to as little as 20% of their diameter as supplied. A wide variety of standard configurations are available from stock in four different rubber and plastic materials for difficult environmental conditions. Any moldable configuration is available with short lead time.

OAKSIDE AT NORTHSIDE • REDWOOD CITY, CALIFORNIA

Print Ins. 5 on Reader Service Card

News and Views

Printed Circuit Sales Up

According to the Institute of Printed Circuits, applications for printed circuit boards continue to grow with sales in 1960 increasing 36% over the figures for 1959. However, profits declined to 3.2%, a drop of 20% from 1959. Actual sales for independent printed circuit producers were about $25-million while it is estimated that another $25-million represents production by manufacturers for internal use.

Permacel Sells Epoxy Line to Hysol

Permacel, Division of Johnson & Johnson, New Brunswick, N. J., has sold its Permacel epoxy electrical insulation potting and encapsulation product line to Hysol Corp., Olean, N. Y. Both firms will continue to produce and market their other traditional product lines.

"Teflon" FEP Prices Down

Du Pont Co. has reduced the price of its "Teflon" FEP-fluorocarbon resin from $9.60 to $6.60 a pound in truckload quantities. A similar $3.00 reduction brings the price of FEP film to $10.00 a pound for films two mils and heavier, $11.50 a pound for one-mil film, and $15.00 a pound for half-mil film.

The film is used as an insulating material for capacitors, flat flexible cable, coils, wire and cable, and printed circuits. The resin is used to mold a variety of electrical and electronic parts including coil forms, insulators, connectors, bushings, etc., and also as a wire and cable insulation.

Du Pont has also introduced a new FEP resin, Teflon 110, for injection molding of complex parts requiring close tolerances, and also a water base dispersion, Teflon 120, for use as a coating impregnant for glass fabrics, yarns, and sleeving.

Burndy Acquires Half of Escon

Burndy Corp. and Glass-Tite Industries Inc. have signed an agreement which gives Burndy a 50 percent interest in Escon Inc., a subsidiary of Glass-Tite. The Escon operation is being renamed Burndy-Escon Inc. Burndy is a large connector producer while Escon has specialized in the design and application of glass and ceramics to electrical connectors for high temperature requirements.

Exhibitors Being Solicited for 4th Electrical Insulation Conference

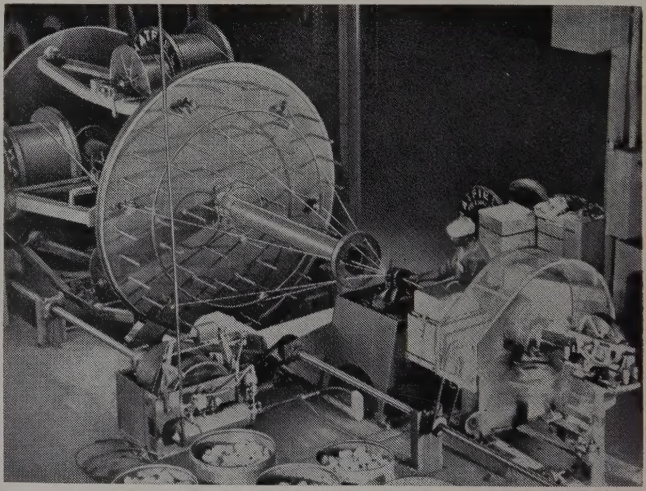
Explanatory brochures and contract forms were sent last month to potential commercial exhibitors at the Fourth Electrical Insulation Conference slated for Feb. 19-22, 1962 at the Shoreham Hotel, Washington, D. C. According to exhibit chairman William J. Dwyer, Suflex Corp., a substantial number of completed contracts have already been returned. Only 133 exhibit spaces are available and it is expected that these will all be sold in a short period of time.

New Lab for NBS

Ground was broken recently for the new National Bureau of Standards laboratories at Gaithersburg, Md. When completed, the new 20-building, $104-million research facility will permit complete relocation of the Bureau from Northwest Washington to the 555-acre site in Montgomery County. The first building under construction is an Engineering Mechanics Laboratory. Later work will include a Radiation Physics Laboratory, seven interconnecting general purpose laboratory buildings, a number of additional special purpose laboratories, and an atomic reactor.

Automated Wire and Cable Production

The Hatfield Wire & Cable Division of Continental Copper & Steel Industries Inc. has opened the first two ($10-million) plants of a projected 63-acre complex at Linden, N. J., designed to be one of the most highly automated and completely integrated facilities in the world for the production of insulated wire and cable. The two plants include an electronically controlled and entirely automated 45,000 square foot copper rod rolling mill which is operated by only three men and a combination rubber mill and wire insulating mill using the newest automatic processes capable of turning out nearly 1,000 miles of finished wire and cable a day. Other buildings planned include a wire drawing mill, a plastic coated wire and cable plant, office buildings, and a refinery for producing electrolytic copper bar. Photo shows giant, high-speed "cable closer" which automatically twists taped or shielded conductor wire into long, continuous reels of heavy, multi-conductor cable.

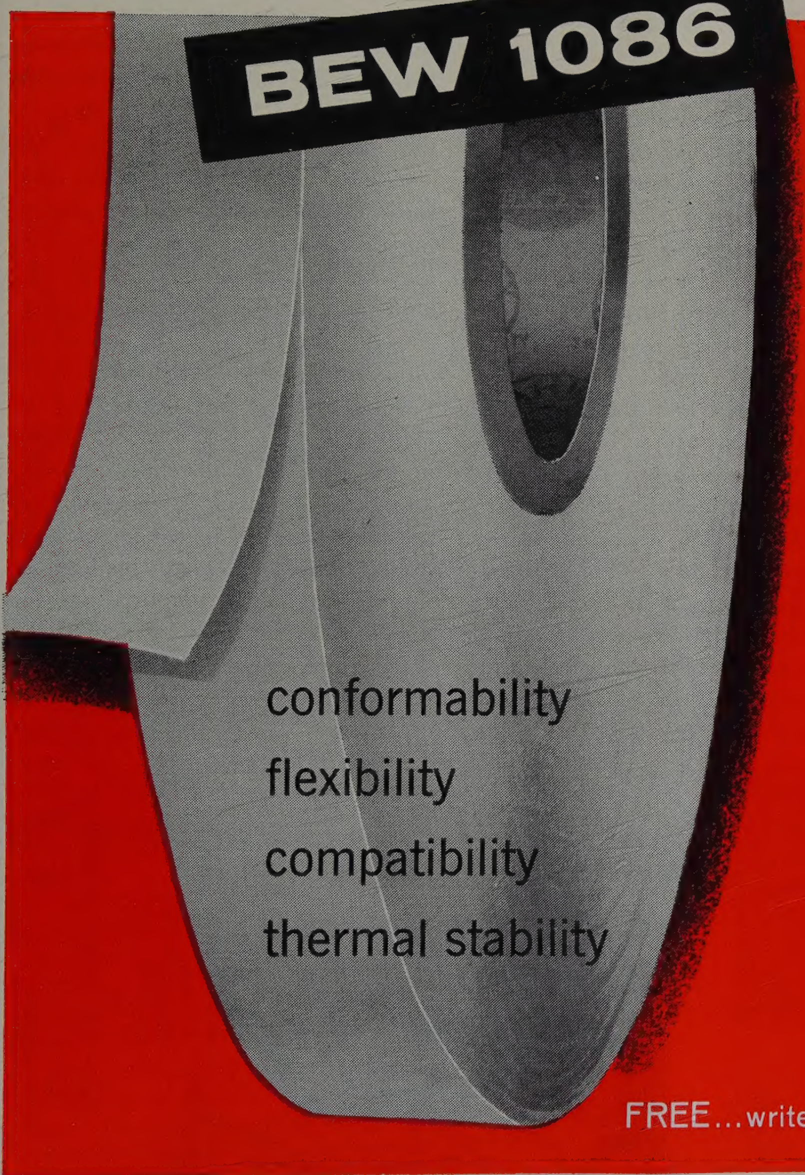


No Interliner Required!

"B" STAGE EPOXY-SATURATED GLASS FABRIC

VARTEX

BEW 1086



Insulating Tape with Built-In Ability!

Vartex BEW 1086, having no interliner, speeds application, and at the same time, offers outstanding mechanical, thermal, and electrical insulating properties. This woven Fiberglas tape is impregnated with heat-resistant epoxy resin processed to the "B" Stage, providing excellent flexibility and conformability for tightly-wrapped coil forms, banding, and armoring. It also has especially strong adherent qualities to most clean substrates, particularly copper. Rigidly self-adhesive when heat-cured, and compatible with a wide range of curing agents and systems, BEW 1086 provides excellent dielectric and mechanical strength, even at high temperatures. BEW 1086 has a distinctive white color in both "B" stage and cured. BEW 1086 has a shelf life in excess of six months if stored at temperatures not over 80°F.

FREE...write for sample and full product data

NJW

NEW JERSEY WOOD FINISHING COMPANY

MANUFACTURERS OF FLEXIBLE ELECTRICAL INSULATION • WOODBRIDGE, N. J.

VARNISHED CAMBRIC CLOTH AND TAPES • VARNISHED "FIBERGLAS"† CLOTH AND TAPES • VARNISHED SILK AND SILK SUBSTITUTE • SYNTHETIC RESINOUS TAPES AND EXTRUDED TUBING • POLYETHYLENE, SHEETS, TAPES AND EXTRUDED TUBING • CABLE WRAPPING TAPES • "VARSIL" SILICONE VARNISHED "FIBERGLAS"† CLOTH AND TAPES • "VARSLOT" COMBINATION SLOT INSULATION: – RAG PAPER AND VARTEX VARNISHED CAMBRIC • FISH PAPER AND VARTEX VARNISHED CAMBRIC • RAG PAPER AND "MYLAR"* POLYESTER FILM • ASBESTOS PAPER AND "MYLAR"* POLYESTER FILM • KRAFT PAPER AND "MYLAR"* POLYESTER FILM • VARTEX VARNISHED "FIBERGLAS"† AND "MYLAR"* POLYESTER FILM • SPECIAL COMBINATIONS AVAILABLE UPON REQUEST

*Mylar, DuPont's registered trademark

†Fiberglas, Owens-Corning Fiberglas registered trademark

Print Ins. 6 on Reader Service Card

Pixilated Patents

By Mike Rivise

Fifty-seventh in a series of odd and interesting inventions in the electronics field from the files of the U.S. Patent Office.

How would you like to go to bed with the device pictured in the illustration ominously dangling above you, knowing that it will drop on your head precisely at the moment you are supposed to get up? While the gentleman in the bed appears to be quite composed at first glance, a closer look shows us that his eyes are not quite closed and that he is warily peering through his eyelashes at the contraption. We would . . . all night.

The alarm device, for which Samuel S. Applegate of Camden N.J., received patent No. 256,265 on April 11, 1882, could also be tripped by electric or other burglar-alarm apparatus, thereby compounding its undesirability to our way of thinking.

Although we do not deny its effectiveness in waking sleepers who are unfortunate enough to be in the correct position when it strikes, one such experience, we are convinced, would be enough to condition us to either smother ourselves all night under pillow or blanket or to sleep on the lower part of the bed.

But perhaps we are being unfair. Read the following excerpts from the patent description and judge for yourself.

"The object of my invention is to construct a simple and effective device for waking persons from sleep at any time which may have previously been determined upon.

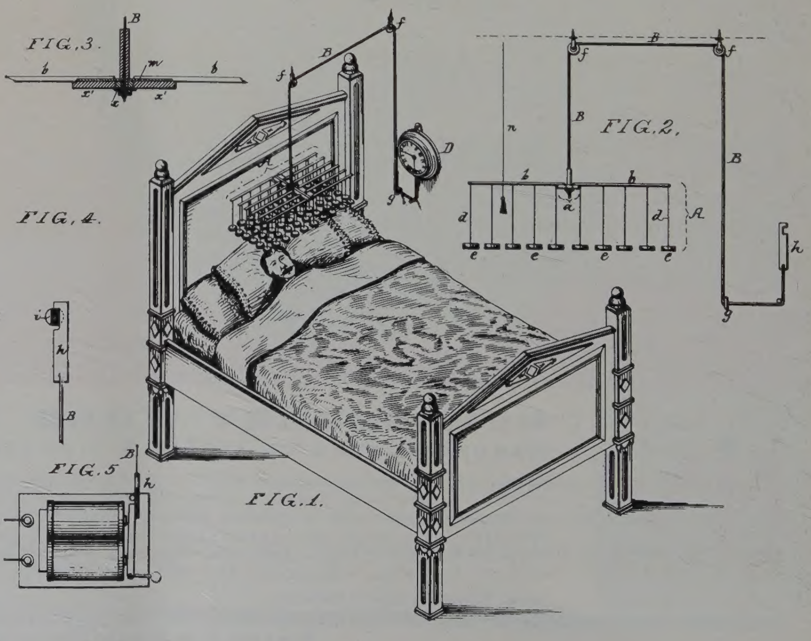
"In carrying out my invention I suspend a light frame in such a position that it will hang directly over the head of the sleeper, the suspending-cord being combined with automatic releasing devices, whereby the frame is at the proper time permitted to fall into the sleeper's face.

"In the drawings, A represents the frame, which consists of a central bar, *a*, having on each side a number of projecting arms, *b*, the whole being made as light as is consistent with proper strength. From each of the arms *b* hang a number of cords, *d*, and to the lower end of each of these cords is secured a small block, *e*, of light wood, preferably cork. These cork blocks, however, are not essential, as tassels or balls of zephyr may be attached to the cords, or the latter alone may be used, or a rectangular frame having a network of cords may take the place of the frame with its pendent cords, the only necessity to be observed in constructing the frame being that when it falls it will strike a light blow, sufficient to awaken the sleeper, but not heavy enough to case pain.

"The cord B, whereby the frame A is suspended, passes through eyes *ff* on the ceiling of the room, or on any other available support, and through an eye, *g*, on the wall, the end of the cord being furnished with a notched plate, *h*, which is so connected to the alarm mechansim of an ordinary alarm-clock, D, that when said alarm is sounded the plate *h* will be released and the frame A will fall.

"I prefer to limit the extent of fall of the frame A so that the bars *a* and *b* of the same will not come into contact with the sleeper's face, this result being attained in the present instance by the contact of the plate *h* with the eye g, through which said plate cannot pass. A suitable stop, adapted to act in conjunction with any one of the eyes through which the cord B passes, may be used, however, to attain this object.

"The notched plate *h* is adapted to engage with the winding-spindle *i* of the alarm mechansim of the clock, as shown in Fig. 4, the spindle being flattened on one side, and the plate being adapted to this flattened portion of the spindle so that when said spindle commences to turn the plate *h* will be released from the control of the same. Various means, however, may be resorted to for effecting the automatic release of the suspending-cord B—for instance, the hour-hand of an ordinary time-piece may be provided with a pin for striking and releasing the plate *h* at a certain hour, or the plate may be retained by the armature of an electro-magnet and released on the attraction of said armature by the magnet, (see Fig. 5,) the circuit being completed by the hands of a clock, or by any of the usual electric burglar-alarm devices connected to the doors or windows of a house."



Spaulding FIBRE FACTS FOR ENGINEERS NUMBER 4

How to Punch Vulcanized Fibre to Reduce Fabrication Costs

by K. H. Alverson, Product Standards Director

Vulcanized Fibre's capacity for easy punching makes this material highly attractive to the designer whose application calls for characteristics such as good dielectric strength, light weight, rugged strength, irregular contours and holes and indentations in the surface of a part.

Punching is done with two kinds of precision: Rough punching uses the lowest cost solid dies, is rapid and economical, but leaves a fractured raw edge and is limited to stock thicknesses through ¼ in.; smooth shaving uses a contour die ground to a sharp edge that slopes away at 45°. The edge shaves stock when the part is forced into the die producing smooth edges in parts up to 1 in. thick. Holes can be punched easily, but should be generally spaced from each other and from any edge by at least the thickness of the stock. Non-circular holes and counterbores should be made circular for machining when the stock thickness specified is too thick to punch.

For thickness under 3/64″, vulcanized fibre can be punched most economically with steel rule dies. Dies for simple parts usually cost much less than solid dies even for irregular contours. Tooling for scoring or creasing can also be added with little additional cost.

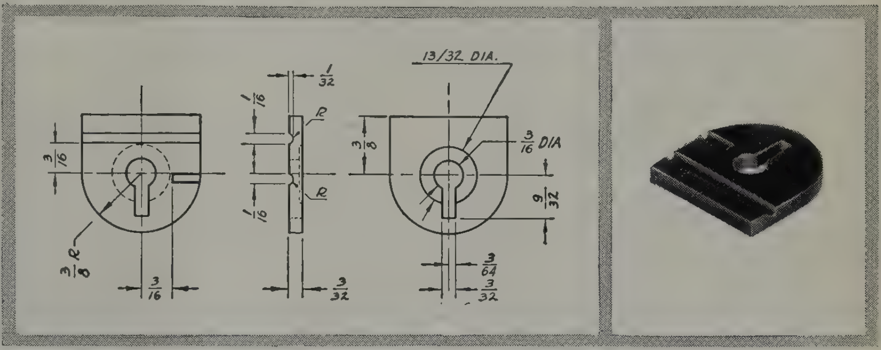
Most parts can be punched without additional conditioning if the vulcanized fibre has its normal moisture content of 5½ to 7%. For especially difficult punchings, or for parts thicker than ⅛″, heating up to 200°F may be desirable.

Additional economies may be obtained in thicknesses 1/16″ and under by using coils slit from parent rolls, reducing waste of stock, speeding up the punching operation, and reducing inspection costs.

Many extras may be incorporated in punching operations on vulcanized fibre. These include scoring or creasing for subsequent forming along established lines. Also practical are swaging or forming into special shapes, such as shoulder bushings or angles.

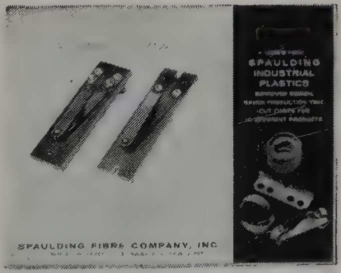
Stamping letters and numerals into the surface of vulcanized fibre in the punch-press operation produces permanently legible markings with no increase in cost of the part. White or colored roll leaf characters can also be impressed into the surface to give color contrast at very little added cost. Punched parts are also readily printed with rubber stamp.

Spaulding Engineers who have been trained in Value Analysis can help you take advantage of the wide range of possibilities in designing to reduce costs through the use of vulcanized fibre parts. They also make available to you Spaulding's extensive fabricating facilities and experience in working with this extraordinary material.



The fabrication of this shut-off switch insulator demonstrates vulcanized fibre's facility for punching and swaging. Previously moulded out of nylon, the part is now made by swaging both sides and punching vulcanized fibre — all in the same operation and at lower costs both for material and processing.

Send for your FREE copies of this literature



Value Analysis Brochure — case histories of design improvement and cost reductions that have been accomplished through Spaulding's value analysis of customer products.

Vulcanized Fibre Engineering Data — a design reference book which comprehensively covers all the application specs of vulcanized fibre.

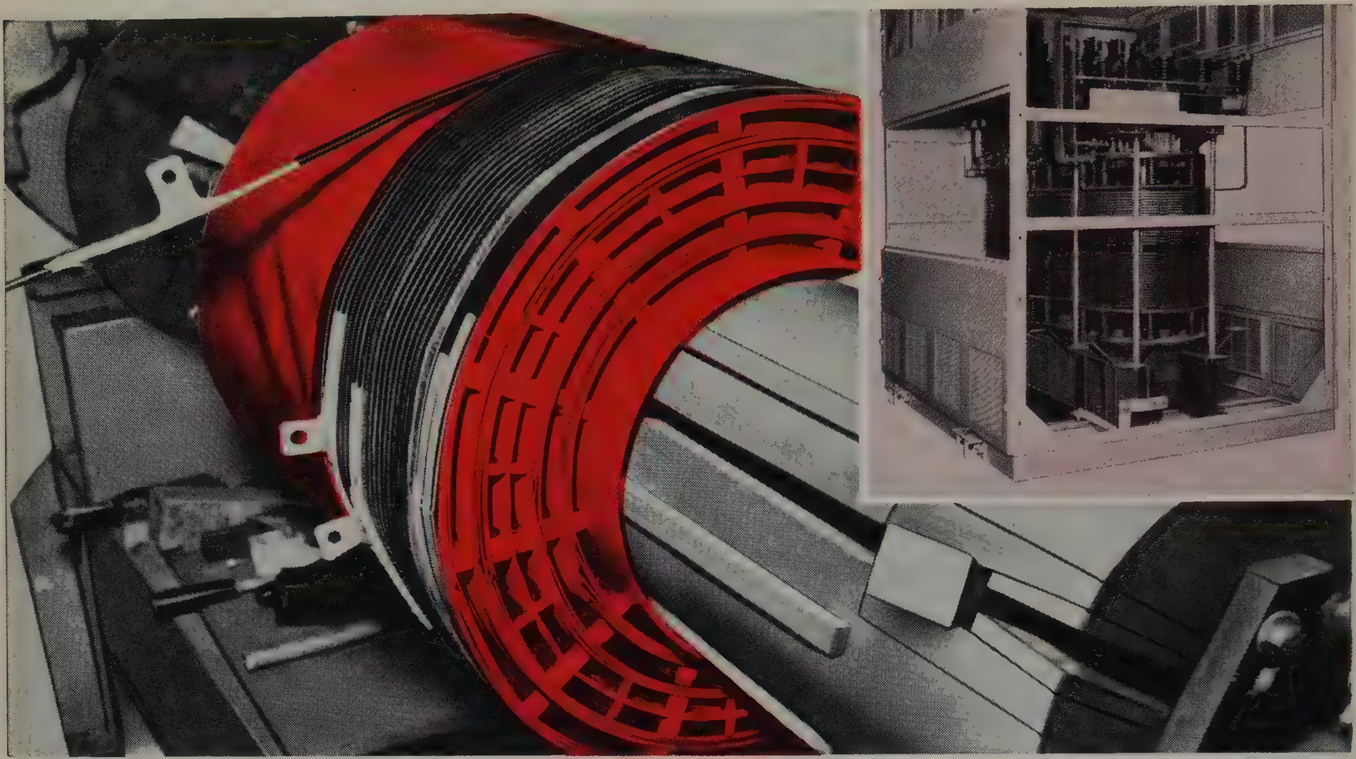
SPAULDING FIBRE COMPANY, INC.

337 Wheeler Street • Tonawanda, New York

Print Ins. 7 on Reader Service Card

SILICONE NEWS from Dow Corning

For Long Service Life



Silicone-Glass Laminates Help Make I-T-E Transformers Reliable, Trouble-Free

Insulating components made from silicone-glass laminates help improve the design and performance of electrical equipment. Bonded with heat-stable Dow Corning silicone resins, glass laminates have high arc resistance, low loss factor, low moisture absorption . . . excellent mechanical and dielectric strength even after prolonged aging at 250 C.

To assure dependable performance of their Class H unit substation transformers, the I-T-E Circuit Breaker Company specifies silicone-glass laminate for spacer strips, the insulating diaphragm between secondary and primary windings, the supporting cylinder, and for interphase barriers.

I-T-E uses this quality construction in ventilated dry-type transformers rated 112½ to 500 KVA; sealed dry-type units rated from 300 to 3000 KVA.

When used with other silicone insulating components, silicone-glass laminates permit smaller, lighter weight transformers that are easier to install and maintain than transformers using any other class of insulation.

Silicone-glass laminates are also widely used for slot wedges, coil dividers, and top sticks in motors; for terminal boards and coil forms in other electrical equipment. Silicone-glass laminates are supplied by leading laminators as tubes, sheets, punched or molded shapes. Write today for full information plus list of fabricators.

PROPERTIES OF SILICONE-GLASS LAMINATE SAMPLES*

Property	Range
Flexural strength, flatwise, psi,	
Lengthwise	20,000-40,000
Crosswise	18,000-33,000
Izod impact strength, edgewise, ft-lb/in. notch	
Lengthwise	6.5-17.0
Crosswise	5.5-14.0
Bonding strength, lbs., ½-inch thickness	
Condition A†	650-1100
Condition D-48/50††	550-950
Water absorption, percent	0.05
Electric strength, volts/mil	
Initial	310
After 200 hr at 260 C	327
After 5000 hr at 260 C	180
Dielectric constant at 10^2 cycles	
Condition A†	3.70
Condition D-24/23††	3.85
Dissipation Factor at 10^2 cycles	
Condition A†	0.0024
Condition D-24/23††	0.0084
Arc resistance, seconds	
Condition A†	180-292
Condition D-48/50††	180-248
Volume Resistivity, meg-cm.	
Condition C-96/35/90‡	1×10^{4}-4×10^{7}
Surface resistivity, megohms	
Condition C-96/35/90‡	10-10,000

* As measured on samples ⅛ inch thick † As received
†† After immersion in water (hours/deg. C.)
‡ After (hours/deg. C./% relative humidity)

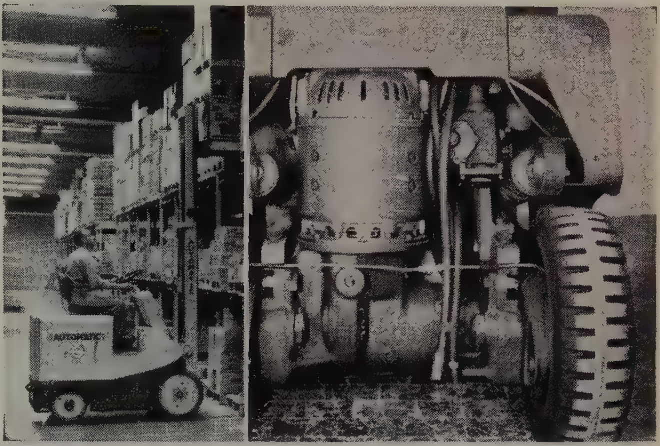
Print Ins. 8A on Reader Service Card

The nearest Dow Corning office is your number one source for information and technical service on silicones.

first in silicones

Dow Corning

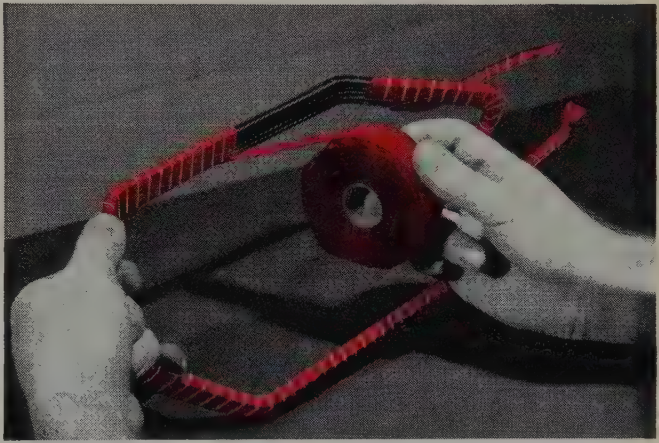
. . . Specify Silicones



Silicones Handle Overloads

Silicone varnish helps make motors safer, more reliable and virtually maintenance-free. These are among the reasons why Automatic Transportation Company, Chicago, uses Dow Corning varnish and a complete silicone insulation system in the drive motors for their line of material handling equipment. These Class H drive motors . . . subjected to inching, frequent starting and reversing, long work cycles, heavy loading when trucks are climbing ramps . . . have more than enough extra capability — assured by the outstanding thermal stability of silicones.

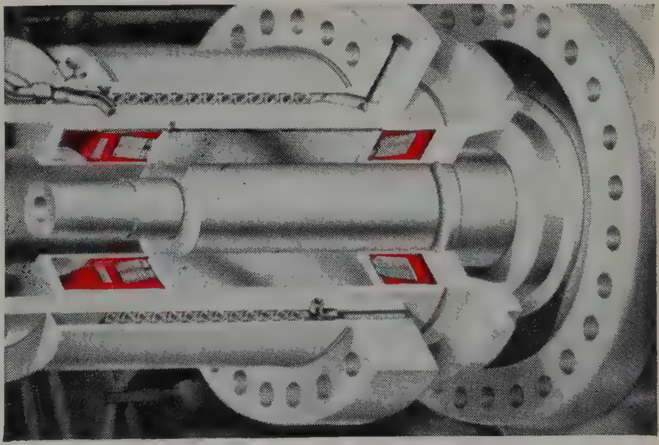
Print Ins. 8B on Reader Service Card



Silicone Rubber Tape Cuts Costs

Triangular Guideline tape, made with Silastic®, the Dow Corning silicone rubber, gives you the superior protection of a silicone insulation system while cutting application costs from 50 to 60% compared with conventional taped systems. A single wrap of Guideline tape is all that's needed to produce the entire primary insulation wall thickness. The tape bonds to itself . . . beveled edges overlap to produce a void-free insulation structure . . . conspicuous center line makes it easy to achieve a precise half-lap wrap of uniform thickness. Guideline tape, made of Silastic, produces a homogeneous, resilient insulation system that resists heat, cold, moisture, abrasives, many chemicals and corrosive atmospheres.

Print Ins. 8C on Reader Service Card



Canned Pump Motor End-Turns Potted

Designed for maximum reliability, Westinghouse removable stator canned motor-pumps like this one are used for better boiler circulation in controlled circulation conventional systems. Similar pumps are used to circulate radioactive liquid coolants at temperatures up to 650 F in hermetically sealed primary coolant systems of nuclear reactors. End-turns of stator coils are potted in Dow Corning solventless silicone resins to insure a solid, void-free fill of coil interstices. These solventless resins are radiation resistant, withstand vibration, oxidation, corona and moisture despite continuous service at high temperatures.

Print Ins. 8D on Reader Service Card

CORPORATION MIDLAND, MICHIGAN

branches: ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D.C.

Insulation Forum

This regular monthly feature is built around a timely question concerning the electrical insulation field. Your suggestions for future questions and participation are invited. This month's question is continued from August:

What are your thoughts regarding the type of educational program, if any, needed to provide the electrical/-electronic insulation industry with qualified engineers and scientists and to provide those already in industry but new to the insulation field with an opportunity to acquire the necessary background in insulation?

E. L. Brancato

Head, Insulation Section, Electromagnetic Materials Branch, Solid State Div., U. S. Naval Research Laboratory, Washington, D. C.

"It may not be obvious, but insulation is the major partner in the electrical industry; without it the industry would not exist. Although critical in importance, electrical insulation is treated as if it were a silent partner. Because of this anonymous status, the problems of insulation needs or applications are not generally dealt with in the engineering schools. Such a neglect might not be serious if the demands upon insulating materials were not increasing. For example, in the past, the requirements for insulating materials were modest and many materials could function as insulation with little or no modification. The present, however, is unfolding an era of new requirements for dielectric materials: decreased weights and dimensions; increased thermal, electrical, and mechanical endurance resistance to a wide range of chemical and radiation environments; etc. As the technical demands upon dielectric materials increase, the number of presently available materials capable of satisfying the new requirements decrease. The relative diminishment of satisfactory insulation materials makes it necessary to develop new materials and to adapt existing insulation to new uses.

"At this point the problem becomes acute. The designer armed with general experience only plans his strategy along trial-and-error tactics. However, the variables dictating the performance of materials are too numerous and too complex to be dealt with effectively in this manner, and the approach becomes a victim of statistics which favor failures over progress in these circumstances. The designer can extricate himself from this predicament by arming himself with the knowledge of materials which reveals the relationship between the molecular structure of materials and their properties. With this knowledge he can begin to create materials with a prescribed structure, or conversely to choose materials from their structure to fulfill specific functions. Only then can the designer face the future with confidence that he can cope with the needs of the more sophisticated technology of today.

"To acquire this knowledge the designer must turn to the educator. Thus the burden of progress falls largely on the shoulders of the educator. The educator can and must help by implementing a curriculum focused on 'Insulation Engineering' or perhaps more broadly on 'Materials Engineering.' Such a curriculum should include, beyond the basic sciences, strong foundations in physics, including the physics of solid state; in chemistry, including physical chemistry; reaction kinetics; chemical thermodynamics; and chemistry of molecular structure and high polymers; and in engineering, including theory of dielectrics, mechanical properties of materials, and instrumental analysis.

"While the burden of new knowledge falls on the schools, the communication of the technical needs is the obligation of industry. The interest of the educator to insulation problems can be aroused by exposing him to the flow of problems arising from the manufacturing, design, and novel application of insulating materials. The educator's role should be made more tangible by inviting his participation in the more basic problems of dielectrics. It is a pleasure to note that the insulation industry has become aware of the need to join forces with the schools and has taken concrete steps to establish closer cooperation between industry and the educator. This effort is described in the editorial 'More on Insulation Education' *(Insulation,* June 1961)."

M. L. Manning

Dean of Engineering, South Dakota State College, Brookings, S.D., and Transformer Consultant, H. K. Porter Co.

Ed. Note: *The following was extracted on Dr. Manning's suggestion from AIEE Paper No. CP 61-853 presented by him at the 1961 Summer General Meeting of the American Institute of Electrical Engineers. Title of the paper is "How to Train the Young Engineer to Apply Basic Principles to the Solution of Insulation Problems." Unfortunately, space limitations do not permit us to include the very comprehensive and imaginative outline of specific topics for both the undergraduate and the graduate programs that Dr. Manning includes in the paper. Readers desiring further information should contact Dr. Manning directly.*

"This paper attempts to outline insulation and insulation system fundamentals which an engineering student must master before facing reality and what the training program after college should be to produce a highly successful engineer in the field of electrical insulation. A six credit (two semester) senior year undergraduate course is proposed, followed by a two year minimum graduate program in industry.

Undergraduate Program:

(Prerequisites: mathematics through vector analysis, general physics and chemistry, atomic physics.)

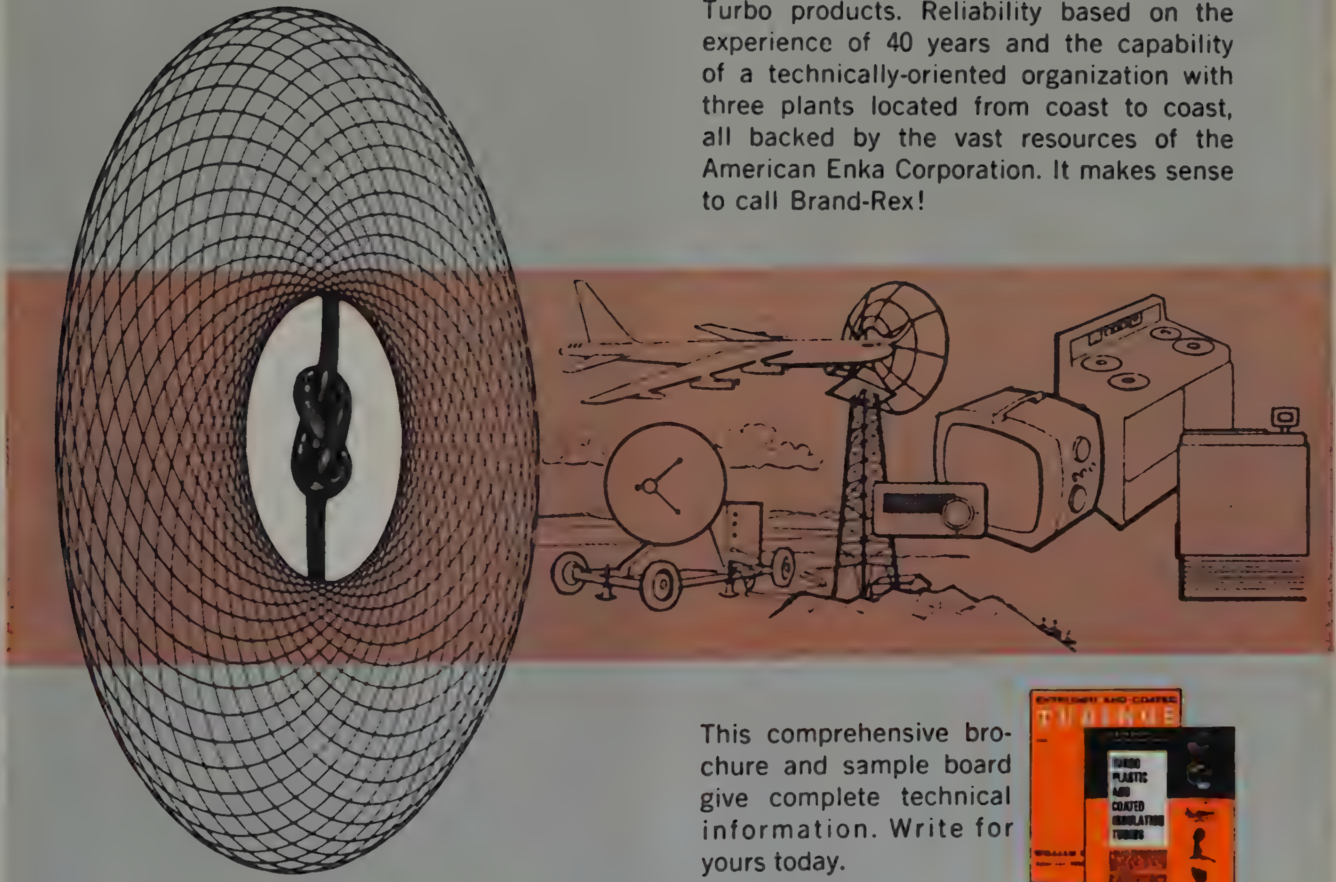
"As a student of the insulation or dielectric circuit, the first consideration should be a thorough study and review of the principles of electrostat-

BRAND-REX
TURBO® INSULATING SLEEVINGS

Circle the entire range of Tubular Dielectrics

To solve insulation problems or to spark new ideas . . . Brand-Rex Turbo sleevings run the spectrum of insulating materials . . . from extruded polyvinyl chloride and teflon tubing to a complete line of cotton, rayon, and glass braids coated with vinyl, silicone, silicone rubber or alkyd varnishes. A complete range of sizes in classes A, B, F and H. Both tubing and zipper tubing configurations available.

Important, too, is the reliability built into Turbo products. Reliability based on the experience of 40 years and the capability of a technically-oriented organization with three plants located from coast to coast, all backed by the vast resources of the American Enka Corporation. It makes sense to call Brand-Rex!



This comprehensive brochure and sample board give complete technical information. Write for yours today.

BRAND
REX

WILLIAM BRAND-REX DIVISION
American ENKA Corporation
DEPT. T, 36 SUDBURY ROAD, CONCORD, MASSACHUSETTS
Vinyl, Teflon, Polyethelene, Nylon and Silicone Rubber Wires and Cables
Electrical Tubing and Sleeving — UHF Cast Plastics — Plastic Extrusions

Print Ins. 9 on Reader Service Card

SPECIFY
EMMCO
for 10 or 10,000
• terminal boards • standard and special terminals • fabricated plastic parts • engraved or silk screen panels • punched parts • special plastic assemblies

One of the industry's leading suppliers, Emmco Plastics Corporation can produce high-quality fabricated plastic parts tailored to your specific electrical or electronic application. A complete staff of skilled personnel, modern manufacturing facilities and rigid quality control procedures enable Emmco to provide fabricated components... in quantity, to close tolerances, at low cost.

FOR MORE INFORMATION on Emmco's capabilities and products, write for free descriptive bulletin, Handy Materials Guide, and Design Specification Sheet. Emmco's Sales Department can also furnish price information or technical assistance on a specific application. Send us your prints for prompt quotations. 301-2

Emmco
PLASTICS CORPORATION
68 VINE STREET, EVERETT, MASSACHUSETTS
DUnkirk 9-1660 TWX: Ever-Mass-152

Print Ins. 10 on Reader Service Card

ics which seem to have been forgotten in today's race in molecular engineering. Next comes electric field plotting, atomic and molecular structure of materials, fundamental notions of units and terms. The concept of insulation systems follows, in sequence, the importance of dielectric constants for assemblies used in condensers, graded cables, porcelain condenser bushings and insulators, motors, transformers, and electronic devices. Problems in basic insulation levels for machines, insulation coordination, testing procedures, and a comparison between dielectric and magnetic circuits generate interest.

Continued Education or Graduate Program:

(Two year minimum graduate program in industry.)

"Armed with the tools proposed in the undergraduate program, the student entering industry has a chance for survival. Now, industry takes its turn by providing experience in a high voltage test laboratory where the young engineer can study the performance of equipment insulation systems at their worst and at their best.

"By continuing this training in an insulation development or research department of the company, combined with comprehensive graduate work leading to a Master's degree in subjects related to voltage distribution in winding of machines, voltage transients, solid-state physics, and molecular engineering, the young engineer acquires, within two to four years, some of the essential knowledge for success. The young engineer must pursue a graduate program if he desires to obtain recognition in the field. This procedure is highly recommended. The importance of writing technical papers and participation in committee work related to standards for insulating materials and systems must not be overlooked. The desire to obtain a fuller understanding of the behavior of materials is always before the young engineer who wishes to be a success in this field. The engineer is concerned with the end-use and his ideas of design, cost, and reliability are not of concern to the scientist. This is our basic difficulty today. Some engineering curricula are geared for the scientific area; industry for the most part demands engineers. The later viewpoint is considered by this paper."

B. S. Kingsbury

Project Engineer, Engineering Laboratories, Wire and Cable Div., The Electric Autolite Co., Port Huron, Mich.

"The insulation industry should depend, to a large extent, upon its own training programs to fill its continuing need for engineers, technicians, and trained sales personnel. The typical engineering degree man must have industry-sponsored opportunities to expand his college training to the practical applications required by industry.

"The beginning technical man may be trained by industry in one or more lines:

a) The chemical selection and compounding of the many organic or inorganic materials so as to secure optimum insulation properties.

b) Technology of applying insulation to the conductors.

c) Mechanical considerations in testing and using the insulated conductor in environments of vibration, abrasion, electrical potential, limited space, radiation, etc.

"Training by industry must relate to the position the man is to fill in the organization. Field representatives should be given considerable time in the Engineering Department. This training includes study of applicable specifications and answering an extended list of prepared questions. Beginning engineers should learn by completing specific product development projects. They may be encouraged to work directly in the plant and on the laboratory testing for their projects. Detailed project reports are a must. Other technicians are encouraged to add to their technical knowledge through courses at the local Junior College."

Belden Lead Wire is easy to strip

and

- solders readily without insulation shrinkage.
- maintains its color identification through baking cycles and impregnations.
- reduces process inspection.
- gives long service life.

Complete stock line of UL voltage and temperature rated wire shown in Catalog L59.

3-2-9

Belden
WIREMAKER FOR INDUSTRY
SINCE 1902
CHICAGO

BELDEN . . . one wire source for everything electrical and electronic

magnet wire • lead wire • power supply cords • cord sets • portable cordage • electronic wire • automotive replacement wire and cable • aircraft wire • electrical household replacement cords

Higher cut-through temperatures with new Formvar/based enamel

A new FORMVAR based magnet wire enamel has been developed specifically for hermetic as well as general purpose service. The new insulation offers excellent cut-thru resistance . . . up to 300°C . . . your assurance of faultless performance during periods of high overload. Also, it offers outstanding resistance to Refrigerant-22. Plus the same service-proven balance of properties of standard FORMVAR-with-phenolic enamels.

Consider this unequalled combination of key properties:

- Refrigerant-22 extractible content below ½%; excellent blister resistance before and after prebake.
- Excellent moisture resistance as determined by the boiling water test.
- Wet dielectric strength greater than 2000 volts per mil after 24 hour submersion in distilled water.
- Electrical resistance retained at elevated temperatures.
- Thermal life of 60,000 to 100,000 hours at 130°C when overcoated with suitable varnishes.

This new enamel has been well proved in the field. The enamel or coated wire is available from your regular supplier under the FORMETIC or other trademark. Consult him for more details on how this new insulation will pay you real dividends in trouble-free performance.

SALES OFFICES: ATLANTA CHICAGO LOS ANGELES NEW YORK SPRINGFIELD CLEVELAND SAN FRANCISCO GREENSBORO ST. LOUIS

IN ENGLAND & EUROPE: SHAWINIGAN LTD., MARLOW HOUSE LLOYD'S AVENUE, LONDON, E. C. 3

FORMVAR®
polyvinyl formal by
SHAWINIGAN RESINS

Print Ins. 12 on Reader Service Card

Thermal Stability of Class F Insulating Varnishes

By C. J. Straka, Materials Laboratories, Westinghouse Electric Corp., Pittsburgh, Pa. All figures courtesy Westinghouse Electric Corp.

Introduction

At the present time, there is a broad interest in the development and application of varnishes with improved thermal stability. Varnishes with a class F (155°C) rating are of particular interest. Manufacturers of commercial insulating varnishes have been, for some time, selling varnishes for applications requiring a material with class F thermal stability. It seemed important at this time to compare the thermal stability of several of these varnishes so that a selection could be made for use in class F applications. To compare the relative thermal lives of these varnishes, the ASTM electric breakdown

Table 1—The Effect of Thermal Aging at 175°C on the Electrical Strength of Glass Cloth Coated with Varnish S

Aging Time, Hours	Specimen Sheet No.	Breakdown in Kilovolts 1	2	3	4	5	Mean	Mean Thickness In Mils	Mean Electric Strength, Volts/Mil	Mean Electric Strength of Specimen, Volts/Mil
200	1	5.6	6.2	6.5	6.9	7.2	6.48	7.0	928	829
	2	5.6	5.6	5.6	2.5	5.5	4.96	6.5	763	
	3	5.3	5.4	5.4	5.1	5.4	5.32	6.2	858	
	4	5.7	3.7	5.6	5.4	5.0	5.08	6.0	848	
	5	5.5	2.0	5.6	5.4	5.8	4.86	6.5	748	
500	1	5.0	5.2	5.4	5.4	5.4	5.28	6.1	867	817
	2	5.4	4.9	4.2	5.6	5.4	5.10	6.2	824	
	3	4.9	5.8	5.8	5.6	5.7	5.56	7.0	795	
	4	5.4	5.3	5.0	4.9	4.7	5.06	6.3	803	
	5	5.0	5.3	5.4	5.5	4.7	5.18	6.5	798	
812	1	4.2	4.2	4.7	4.6	5.0	4.54	7.5	607	605
	2	4.4	4.1	4.2	4.6	4.2	4.30	6.5	662	
	3	4.4	4.2	4.4	2.4	1.4	3.36	6.5	518	
	4	4.6	4.7	4.2	4.4	3.0	4.18	7.0	598	
	5	3.8	4.0	4.4	4.3	4.2	4.14	6.5	638	
1100	1	2.6	3.2	4.0	3 0	1.6	2.88	6.0	478	485
	2	1.7	4.2	3.6	2.2	2.4	2.82	7.0	404	
	3	1.4	3.0	3.8	3.4	3.6	3.04	7.0	434	
	4	2.7	1.9	2.4	4.2	3.6	3.96	7.0	608	
	5	4.0	3.8	2.6	2.0	2.6	3.00	6.5	500	
1200	1	3.6	1.8	2.6	1.6	2.4	2.40	7.5	320	387
	2	2.6	3.4	3.4	2.8	1.8	2.80	6.5	432	
	3	3.3	3.8	2.8	3.0	3.6	3.30	6.5	508	
	4	1.8	2.2	2.1	2.2	2.2	2.10	7.0	300	
	5	2.0	3.2	2.8	2.6	2.4	2.60	6.9	377	
1400	1	2.2	1.8	1.8	1.4	1.8	1.80	7.1	254	257
	2	2.0	1.6	1.4	1.2	1.8	1.60	6.2	258	
	3	1.5	2.0	1.0	1.6	1.4	1.50	6.1	246	
	4	1.7	1.7	1.9	1.3	1.9	1.70	6.1	279	
	5	1.6	1.6	1.8	1.3	1.7	1.60	6.5	247	
1514	1	1.2	1.2	1.4	1.5	1.3	1.32	7.0	189	191
	2	1.3	1.2	1.4	1.4	1.3	1.32	7.0	189	
	3	1.3	1.2	1.1	1.2	1.3	1.22	6.8	180	
	4	1.2	1.3	1.2	1.3	1.2	1.24	6.5	191	
	5	1.2	1.5	1.3	1.3	1.1	1.28	6.2	207	
1848	1	0.9	0.9	1.1	1.0	1.0	0.98	6.1	161	162
	2	1.2	1.1	1.3	1.0	0.9	1.10	6.2	178	
	3	1.1	1.1	1.2	1.0	1.1	1.10	6.0	183	
	4	0.9	0.9	1.1	1.1	1.0	1.00	7.5	133	
	5	0.8	1.1	1.0	1.0	1.1	1.00	6.5	154	
2000	1	0.6	0.6	0.7	0.7	0.7	0.66	6.5	102	120
	2	0.8	0.7	0.9	0.9	1.0	0.86	7.0	123	
	3	0.7	0.8	0.7	0.9	1.0	0.82	6.5	126	
	4	0.9	0.7	0.8	1.0	1.0	0.88	9.0	98	
	5	0.9	1.0	0.9	0.7	1.0	0.90	6.0	150	
3000	1	1.1	1.0	0.9	0.9	1.1	1.00	6.5	154	153
	2	0.6	0.8	1.0	1.0	1.6	1.00	6.3	159	
	3	1.0	1.0	1.0	0.9	1.1	1.00	6.5	154	
	4	0.9	0.9	1.0	1.1	1.1	1.00	7.0	143	
	5	0.8	1.1	1.1	1.0	1.0	1.00	6.5	154	

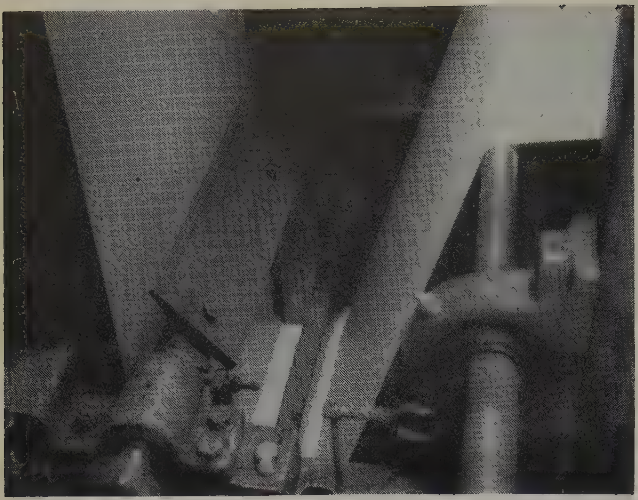


Figure 1, method of coating.

procedure was selected. Details concerning this method of testing have been previously presented.[1]

Up to the present time, however, a convenient method for rating the thermal stability of varnishes has not been established. Such a method would facilitate comparison between varnishes and provide a number or letter to designate each class for purposes of standardization.

A thermal stability test procedure for varnishes should be accurate and reproducible and there should be a reasonable correlation between the test and the thermal life of varnishes in a compatible insulation system as measured by functional tests such as described in AIEE 510.

Varnish test procedures, however, cannot take into account all the many different influences that affect the life of insulation in different equipment and applications. The useful life of a varnish in a particular piece of electric equipment may be quite different from the life determined

Table 2—The Effect of Thermal Aging at 200°C on the Electric Strength of Glass Cloth Coated with Varnish S

Aging Time, Hours	Specimen Sheet No.	Breakdown in Kilovolts						Mean Thickness In Mils	Mean Electric Strength, Volts/Mil	Mean Electric Strength of Specimen, Volts/Mil
		1	2	3	4	5	Mean			
52	1	7.0	7.0	7.0	7.0	7.0	7.00	8.0	875	810
	2	5.0	5.0	5.2	5.0	5.0	5.04	6.2	813	
		3.2	5.4	5.4	5.0	5.2	4.84	6.5	748	
	4	4.8	5.2	5.2	5.2	5.0	5.08	6.5	784	
	5	5.6	6.0	5.6	5.6	3.0	5.16	6.2	832	
100	1	4.6	4.8	4.0	4.6	4.6	4.52	6.5	694	689
	2	5.0	5.0	5.5	5.8	5.0	5.26	7.9	666	
	3	4.6	4.0	4.6	4.2	3.6	4.20	6.5	647	
	4	4.7	5.0	4.4	4.4	3.6	4.42	6.5	680	
	5	4.3	5.0	4.5	5.0	4.6	4.68	6.2	757	
200	1	4.5	3.8	5.0	3.0	3.0	3.85	6.9	559	575
	2	3.5	4.0	3.6	4.2	3.8	3.82	6.2	617	
	3	1.7	4.1	3.7	4.3	4.2	3.60	6.5	554	
	4	4.5	3.4	4.5	3.4	4.2	4.00	6.5	617	
	5	2.6	3.4	2.2	4.5	4.5	3.44	6.5	530	
304	1	1.6	1.4	4.0	4.1	2.2	2.66	7.6	350	337
	2	2.4	2.4	3.0	3.8	1.3	2.58	6.5	396	
	3	1.4	1.3	1.6	3.8	2.4	2.10	6.5	324	
	4	1.4	1.4	1.4	4.2	2.0	2.08	8.0	260	
	5	3.3	1.5	3.6	1.8	1.4	2.32	6.5	357	
500	1	0.7	1.0	0.9	1.1	1.1	0.96	7.5	128	160
	2	1.0	1.1	1.0	1.1	1.0	1.04	6.5	160	
	3	1.1	1.1	1.1	1.1	1.1	1.10	6.0	183	
	4	1.0	1.1	1.1	1.0	1.1	1.06	6.5	163	
	5	1.1	1.1	1.1	1.1	1.1	1.10	6.5	169	
600	1	0.6	0.7	0.7	0.8	0.8	0.72	6.2	116	133
	2	0.9	0.9	0.9	0.8	0.9	0.88	6.1	144	
	3	0.8	0.8	0.8	0.8	0.9	0.82	6.0	137	
	4	0.9	0.9	0.9	0.9	0.9	0.90	7.8	116	
	5	0.9	0.9	0.9	1.0	0.92	0.92	6.1	151	
845	1	1.2	1.2	1.2	0.9	0.8	1.06	6.5	163	161
	2	1.0	1.0	1.1	1.2	1.2	1.10	6.5	169	
	3	1.0	1.1	1.1	1.0	1.2	1.08	6.5	166	
	4	1.1	0.9	1.2	1.1	1.0	1.06	7.5	142	
	5	1.0	1.0	1.0	0.9	1.1	1.00	6.0	167	
1000	1	0.5	0.5	0.6	0.6	0.5	0.52	7.0	75	98
	2	0.5	0.5	0.5	0.6	0.6	0.54	6.1	89	
	3	0.6	0.6	0.6	0.7	0.7	0.64	6.5	99	
	4	0.8	0.8	0.6	0.8	0.7	0.74	7.5	99	
	5	0.8	0.7	0.9	0.7	0.8	0.80	6.2	129	
1248	1	1.0	1.0	0.9	0.8	0.9	0.92	6.0	153	149
	2	1.0	1.1	1.0	1.1	1.0	1.04	6.5	160	
	3	1.0	1.0	1.0	1.0	1.0	1.00	7.0	143	
	4	1.1	1.0	1.0	1.0	1.0	1.02	6.5	157	
	5	1.1	1.1	1.1	1.0	1.0	1.06	8.0	133	

by testing the varnish alone. It should also be recognized that the life of a varnish used in one type of electric equipment may be different from the life of the varnish applied in another type of equipment. Therefore, the performance of insulating varnishes in electric equipment and in combination with other materials should be determined by insulation system tests.

Varnish test procedures, such as the ASTM curved electrode breakdown procedure, can provide thermal life data that can be used to determine the relative thermal lives of insulating varnishes. Using this test procedure, the test life of an accepted varnish as a function of temperature can be determined. Since the temperature classification of a varnish that has been accepted for a long time will have been established by field experience, its life-temperature characteristics by laboratory thermal stability test provide a basis for comparison with the thermal life of a new varnish. By assigning a thermal

Table 3—The Effect of Thermal Aging at 225°C on the Electrical Strength of Glass Cloth Coated with Varnish S

Aging Time, Hours	Specimen Sheet No.	Breakdown in Kilovolts 1	2	3	4	5	Mean	Mean Thickness In Mils	Mean Electric Strength, Volts/Mil	Mean Electric Strength of Specimen, Volts/Mil
No Aging	1	10.0	10.0	11.0	11.0	9.5	10.30	7.0	1490	1448
	2	9.5	10.0	9.5	10.0	10.0	9.80	7.0	1400	
	3	10.0	11.0	10.0	10.0	10.0	10.20	7.0	1460	
	4	9.0	9.0	9.5	9.0	10.0	9.30	6.5	1430	
	5	9.0	11.0	9.0	11.0	11.0	10.20	7.0	1460	
8½	1	5.0	5.9	4.8	5.2	2.4	4.66	6.5	717	801
	2	6.4	4.4	6.8	7.2	7.2	6.40	7.5	853	
	3	5.8	2.8	5.4	5.4	6.0	5.08	6.0	848	
	4	5.0	5.4	6.0	4.6	5.2	5.24	6.0	875	
	5	2.1	5.6	5.7	5.4	4.3	4.62	6.5	711	
20	1	5.3	5.2	4.0	5.4	5.4	5.06	6.5	778	712
	2	4.8	4.1	4.1	5.2	2.3	4.10	6.5	632	
	3	6.4	6.0	6.6	5.9	4.7	5.92	7.5	790	
	4	5.0	2.0	4.3	4.4	2.8	3.70	6.0	617	
	5	4.5	4.7	4.4	5.3	5.3	4.82	6.5	742	
44	1	[illegible].3	5.1	3.6	4.9	3.8	4.14	7.5	552	541
	2	3.0	3.2	2.6	3.1	3.0	2.98	6.5	459	
	3	2.1	3.8	4.0	3.4	4.0	3.46	6.5	532	
	4	2.8	2.4	3.4	4.7	4.1	3.48	6.5	587	
	5	2.7	5.0	2.9	3.6	4.5	3.74	6.5	577	
68	1	4.6	5.4	5.2	4.9	3.1	4.04	7.0	664	600
	2	4.0	4.2	2.6	2.8	3.4	3.40	6.0	567	
	3	3.4	3.2	3.8	3.7	2.3	3.28	6.0	548	
	4	5.0	3.9	5.5	5.3	3.0	4.54	7.0	650	
	5	4.5	4.7	2.7	2.8	3.9	3.72	6.5	573	
80	1	3.3	2.8	4.5	5.0	2.0	3.52	6.5	542	590
	2	3.8	3.6	2.0	3.2	3.5	3.22	6.0	538	
	3	4.2	4.2	4.3	2.3	4.5	3.90	6.0	652	
	4	4.6	4.0	4.0	4.4	4.0	4.20	6.0	700	
	5	2.4	1.6	3.7	4.5	3.4	3.12	6.0	520	
101	1	1.0	1.2	1.0	1.4	1.5	1.22	6.5	188	279
	2	1.8	2.0	1.6	1.6	1.0	1.60	6.0	267	
	3	1.5	1.5	1.6	2.4	1.1	1.62	7.0	231	
	4	3.6	3.4	4.0	3.0	—	3.50	6.5	534	
	5	0.9	1.0	1.2	1.2	1.4	1.14	6.5	176	
140	1	1.0	1.2	1.2	1.3	1.3	1.20	6.5	185	195
	2	1.2	1.2	1.1	1.3	1.2	1.20	6.0	200	
	3	1.1	1.1	1.3	1.3	1.4	1.24	6.0	207	
	4	1.3	1.2	1.2	1.3	1.2	1.24	7.0	178	
	5	1.3	1.1	1.3	1.2	1.2	1.22	6.0	204	
200	1	0.6	0.8	0.8	0.8	0.9	0.78	6.5	120	123
	2	0.8	0.8	0.8	0.8	0.8	0.80	6.5	123	
	3	0.8	0.8	0.8	0.8	0.8	0.80	6.5	123	
	4	0.9	0.8	0.8	0.9	0.8	0.84	7.5	112	
	5	0.9	0.9	0.9	0.8	0.9	0.88	6.5	136	
264	1	1.0	0.9	0.9	0.5	0.9	0.84	6.5	129	126
	2	0.9	0.8	0.9	0.8	0.9	0.82	6.5	126	
	3	0.9	0.9	0.8	0.7	0.9	0.84	6.5	129	
	4	0.9	0.9	0.9	0.9	0.8	0.88	7.0	126	
	5	0.8	0.8	0.8	0.8	0.7	0.78	6.5	120	
296	1	0.9	0.8	0.9	0.9	0.8	0.86	6.5	132	127
	2	0.8	0.9	0.8	0.9	0.8	0.84	6.5	129	
	3	0.9	0.8	0.8	0.8	0.9	0.84	7.0	120	
	4	0.8	0.8	0.9	0.8	0.9	0.84	6.5	129	
	5	0.9	0.7	0.8	0.9	0.8	0.82	6.5	126	

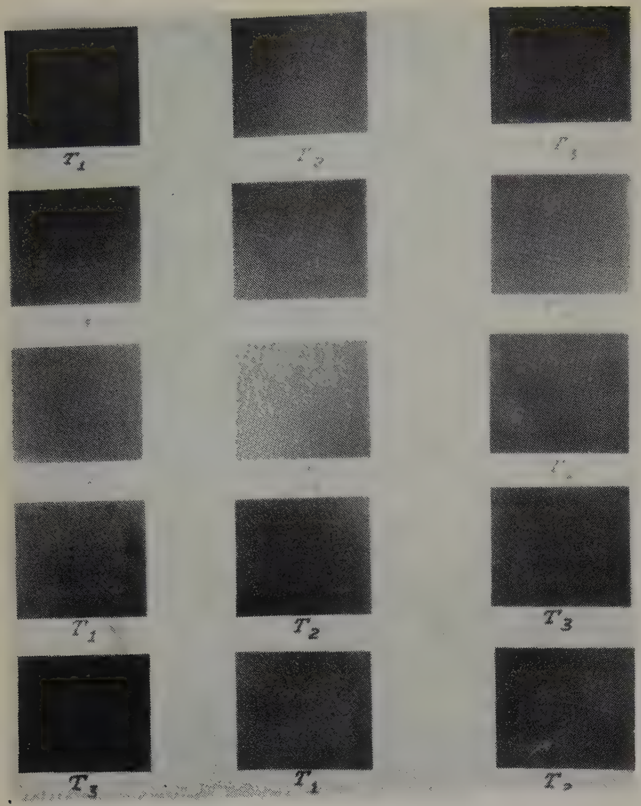


Figure 2, method of specimen selection.

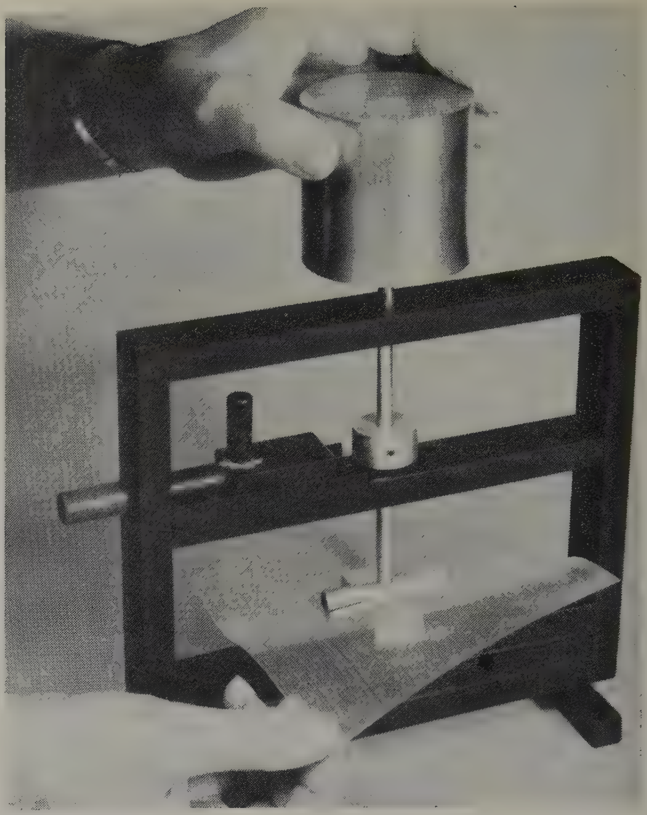


Figure 3, electric strength testing apparatus.

Table 4—Calculated Constants of Equations* for the Relationship of Logarithm of Electric Strength and Aging Time of Glass Fabric Coated with Several Commercial Varnishes

Varnish	Aging Temperature, °C 175		200		225		250		260	
	a	b	a	b	a	b	a	b	a	b
A					3.0973	–0.000329	3.131	–0.00165	3.172	–0.00338
B			3.183	–0.000108	3.0538	–0.000558	3.105	–0.00221	3.124	–0.00345
C			3.0893	–0.000135	2.924	–0.000705	3.0448	–0.00348	3.173	–0.00641
D			3.07 6	–0.000145	3.0996	–0.00148	3.0825	–0.00414		
E			3.130	–0.000207	3.0521	–0.000869	3.158	–0.00535		
F			3.195	–0.000246	3.164	–0.000739	3.199	–0.00443		
G			3.114	–0.000148	3.133	–0.000685	3.0270	–0.00129		
H	3.156	–0.000108	3.156	–0.000805	3.110	–0.00323				
I			3.116	–0.000305	3.0463	–0.00162	3.106	–0.00437	3.174	–0.00615
J			3.062	–0.000402	3.0224	–0.00154	3.0093	–0.00497		
K			3.126	–0.000474	3.0977	–0.00147	3.0932	–0.00568		
M	2.967	–0.000109	2.949	–0.000569	2.943	–0.000248				
S	3.132	–0.000500	3.070	–0.00175	3.036	–0.00512				

$\log Y = a + bx$

*The relationship between electric strength and aging time is expressed as:

$\log$ (Electric Strength in Volts/Mil) $= a + b$ (aging time in hours)

life value for this test procedure, based on the test life of accepted varnishes, the temperature class of new varnishes may thus be established.

Specimen Preparation

Five gallon samples of 11 different varnishes were purchased from various suppliers. These varnishes were sold for use in class F applications (155°C - 180 degrees C).

Heat cleaned glass fabric 18 inches wide and 4 mils thick was coated in a continuous operation on a laboratory vertical coating machine, shown in figure 1, using the 11 commercial insulation varnishes.

Each varnish was applied in three coats to give a total thickness of approximately 7 mils. The first coat was scraped on both sides in order to force the varnish into the fabric. Subsequent coats of varnish were straight dipped without scraping. Each coat was baked 4 minutes at 110°C and then 7 minutes at either 200°C to 250°C, depending on the tackiness at the lower temperature cure.

The continuous roll of coated fabric was cut into 12 sheets approximately 23 inches long. Specimens 4½ inches long and 5 inches wide were cut from the sheets and coded as shown in figure 2. This random selection of specimens was adopted in order to minimize errors due to variations in processing.

Five specimens with identical coding from each sheet

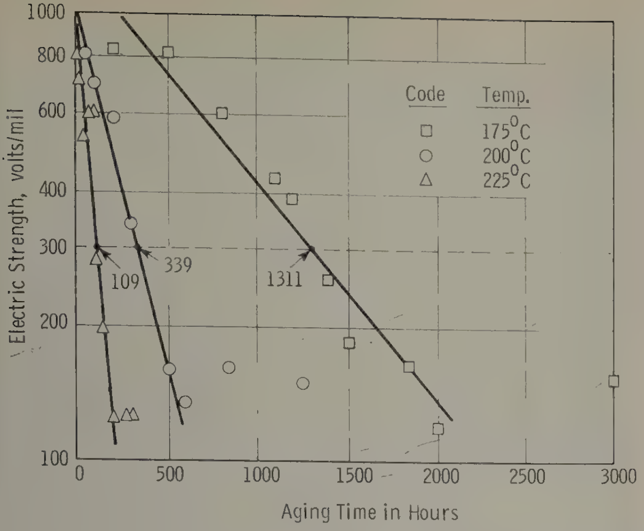


Figure 4, effect of aging on electric strength of glass cloth coated with varnish S evaluated by ASTM breakdown method.

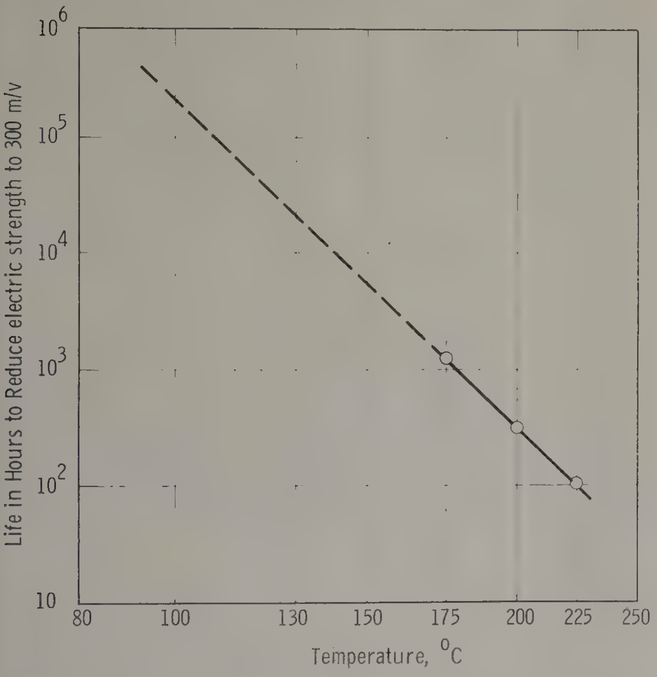


Figure 5, Thermal life chart for varnish S evaluated by ASTM electric breakdown method.

were grouped into sets. All sets coded T_1 were aged at the same temperature. In a similar manner, sets coded T_2 and T_3 were used at other temperatures. All specimens that were aged were suspended vertically in circulating air ovens maintained at the desired aging temperature.

Aging Specimens

All specimens that were aged were suspended vertically by means of modified "Bull-Dog" clips arranged on metal racks. A clip was also attached to the bottom of the sheets to keep the sheets in a straight position free of wrinkling and warping.

Each metal rack held a set of 5 specimens. These racks were placed in circulating air ovens maintained at the desired aging temperature. In removing specimens from ovens, the racks with specimens intact were taken out and

Table 5—Predicted Life of Several Commercial Varnishes Based on the Calculated Relations Between Aging Time and Log of Electric Strength

Varnish	Temp., °C	Predicted Life In Hours	95% Confidence Limits		Standard Deviation
			Low	High	
A	225	1880	1500	2270	0.0496
	250	397	364	430	0.0329
	260	205	173	238	0.0507
B	200	6560	5650	7470	0.0470
	225	1030	530	1540	0.148
	250	284	220	350	0.103
	260	187	40	330	0.0677
C	200	4550	3430	5670	0.0632
	225	634	300	965	0.166
	250	163	109	217	0.127
	260	109	93	124	0.0209
D	200	4110	3430	4790	0.0939
	225	421	383	459	0.0891
	250	146	130	163	0.109
E	200	3140	2740	3550	0.0984
	225	661	594	729	0.0773
	250	127	110	145	0.130
F	200	2920	2720	3110	0.0541
	225	931	857	1000	0.0612
	250	163	136	190	0.1094
G	200	1300	3750	4850	0.0651
	225	958	885	1030	0.0616
	250	126	350	500	0.0881
H	175	6260	5490	7040	0.0518
	200	843	785	900	0.0827
	225	196	167	225	0.1298
I	200	2090	1820	2370	0.0423
	225	351	236	466	0.116
	250	144	92	196	0.101
	260	113	5	222	0.137
J	200	1450	1035	1870	0.0686
	225	354	262	446	0.0750
	250	107	6	220	0.2172
K	200	1370	1070	1670	0.0689
	225	422	326	517	0.0733
	250	108	74.2	143	0.0416
M	175	4500	1800	13500	0.0204
	200	830	410	1320	0.0113
	225	190	75	340	0.0161
S	175	1310	920	1770	0.00706
	200	340	235	465	0.00580
	225	110	55	185	0.0155

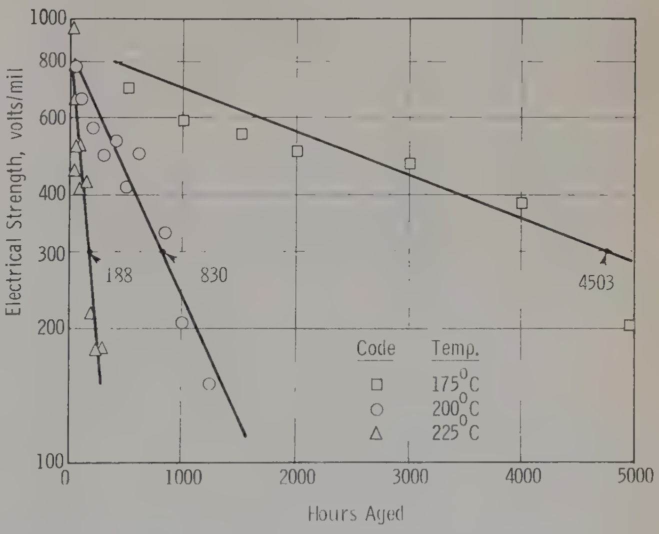


Figure 6, effect of aging on electric strength of glass cloth coated with varnish M evaluated by ASTM breakdown.

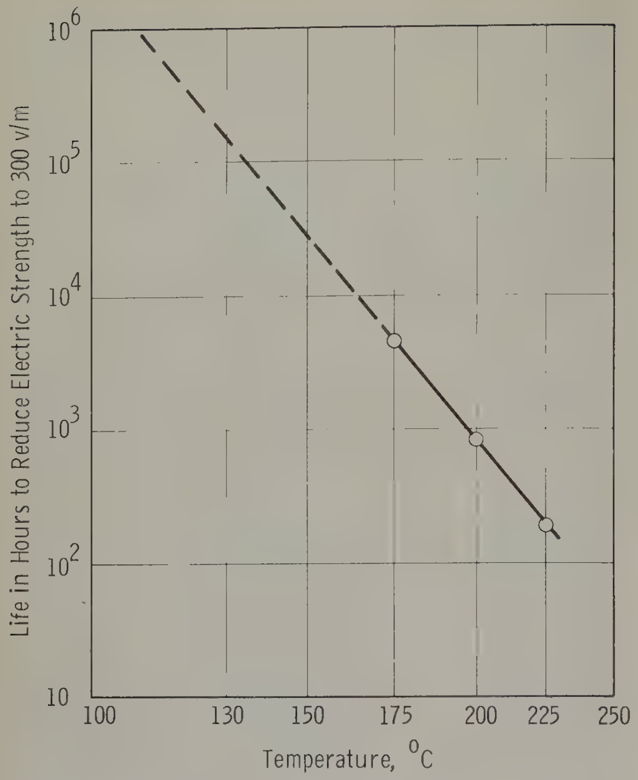


Figure 7, thermal life chart for varnish M evaluated by ASTM electric breakdown method.

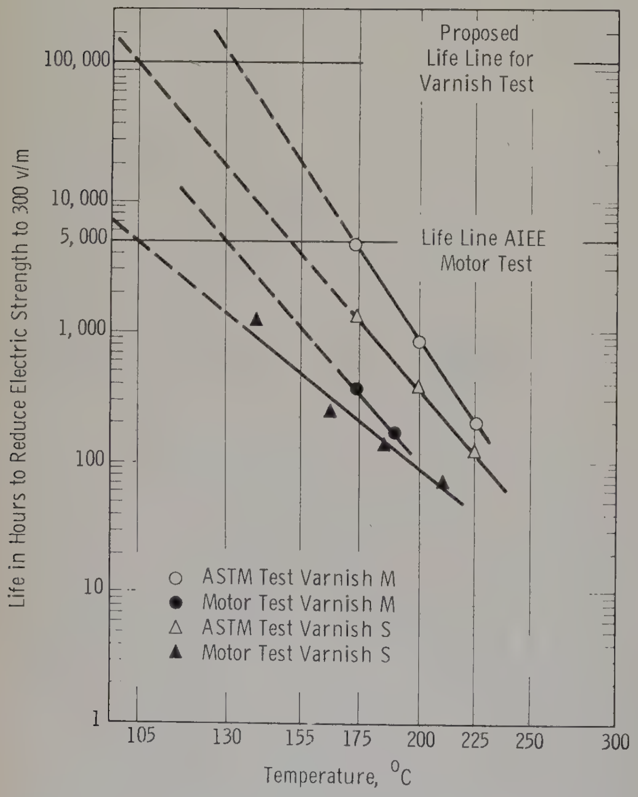


Figure 8, comparison of thermal life of M and S varnishes evaluated by ASTM electric breakdown procedure and AIEE No. 510 motor test procedure.

placed in the test chamber for conditioning at 50 percent relative humidity for a minimum of four hours before testing.

The ovens used for aging were of the conventional forced air type maintained at the desired temperature with a range of ±1 degree. The doors of the oven were opened only when removing specimens and because of the convenient rack arrangement, the time interval during opening was at a minimum.

Electrical Breakdown Tests

The ASTM test procedure uses a varnished glass fabric test specimen and employs a curved electrode test fixture which elongates the outer surface of the specimen about two percent. The elongation is intended to increase the significance of the test with respect to service conditions.

The electric breakdown test procedure measures the decay in electric strength during thermal aging at elevated temperatures. Thermal life, by this method, is defined as the number of hours required to age the specimen to reduce the electric strength to a value of 300 volts per mil

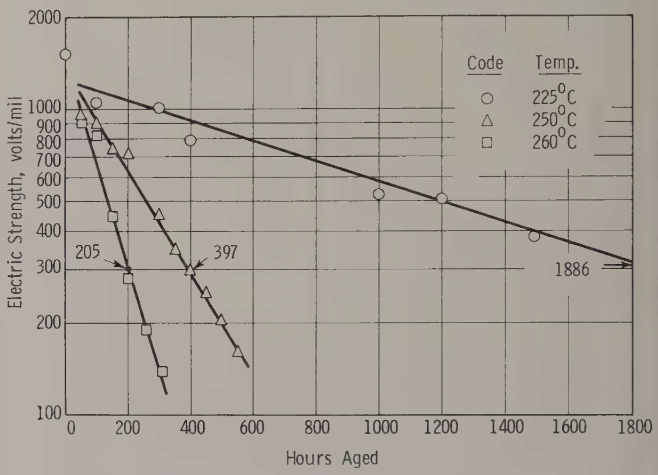


Figure 9, effect of aging on electric strength of glass cloth coated with varnish A.

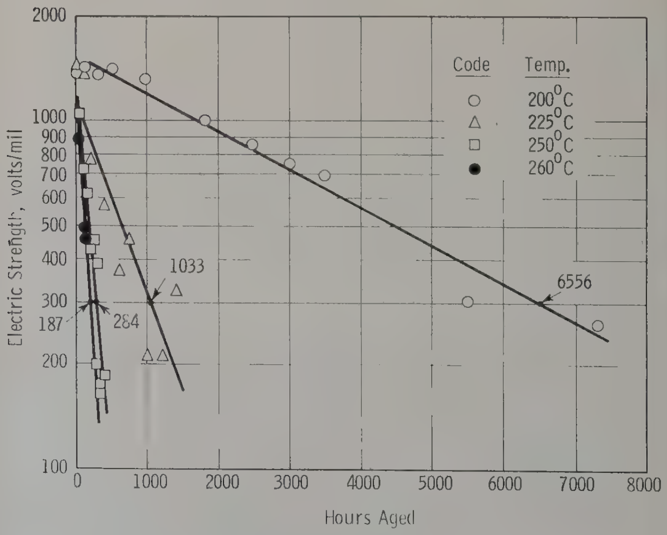


Figure 10, effect of aging on electric strength of glass cloth coated with varnish B.

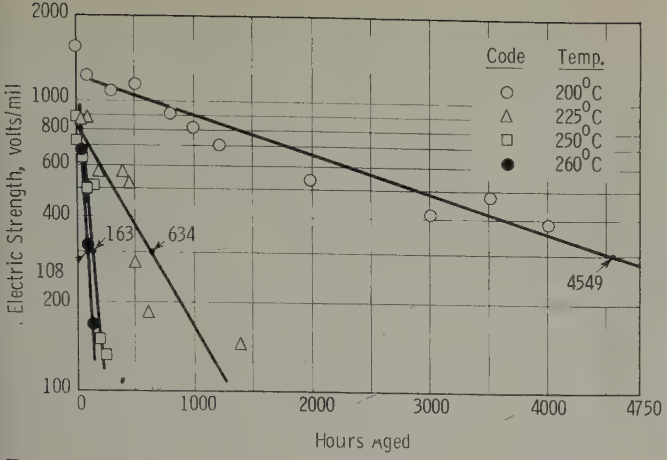


Figure 11, effect of aging on electric strength of glass cloth coated with varnish C.

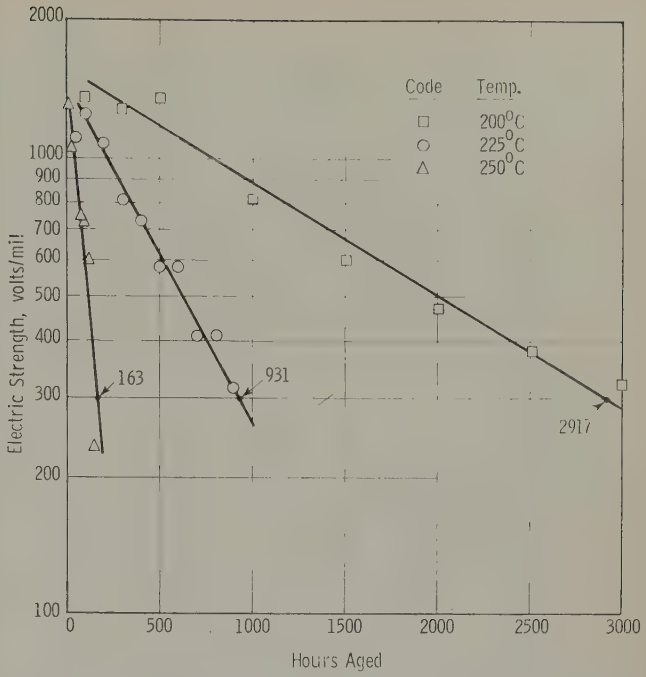


Figure 14, effect of aging on electric strength of glass cloth coated with varnish F.

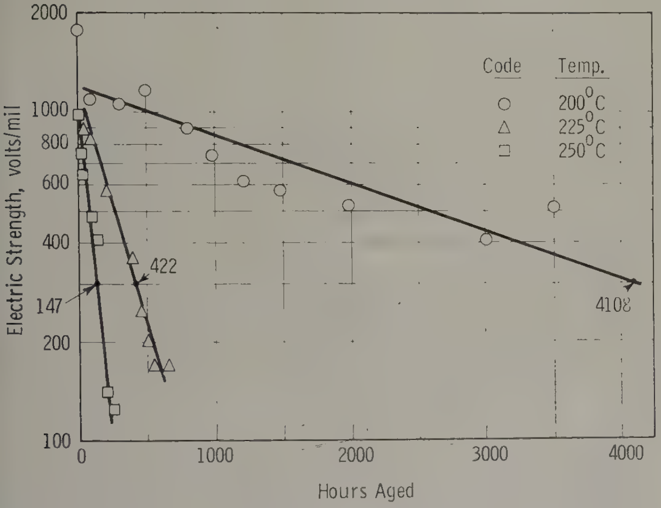


Figure 12, effect of aging on electric strength of glass cloth coated with varnish D.

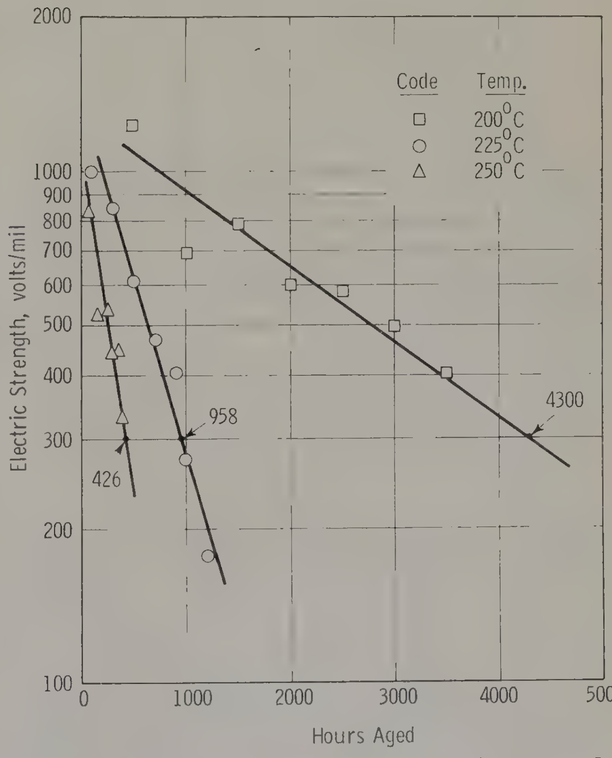


Figure 15, effect of aging on electric strength of glass cloth coated with varnish G.

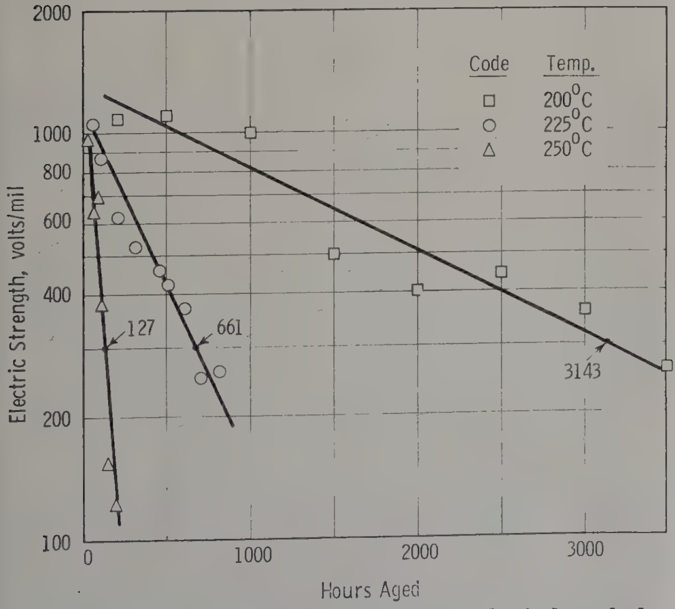


Figure 13, effect of aging on electric strength of glass cloth coated with varnish E.

after a single heat shock and a single flexing.

The electrode system in this procedure, which is shown in figure 3, consists of a pair of curved electrodes arranged with a fixed force applied to the upper electrode. The lower electrode is supported on a rubber cushion to allow better alignment of the two electrodes. This assembly is mounted inside a "Plexiglas" chamber which is maintained at an approximate relative humidity of 50 percent using a standard solution of calcium nitrate.

After thermal aging at elevated temperature and conditioning in the chamber for at least four hours, the glass fabric specimen is tested near the four corners and center areas of the sheet. With the specimen held between the curved electrodes, an electric stress is applied at a rate of 500 volts per second until breakdown occurs.

A convenient method for handling the electric breakdown test data was used. By plotting the logarithm of electric strength versus aging time, a straight line relationship is obtained. From such a plot, the time to reach a certain point of deterioration, which in this case is 300 volts per mil, is selected with more confidence.

A thermal life chart is then prepared by cross plotting the logarithm of the life in hours needed to reduce the electric strength to 300 volts per mil versus the reciprocal of the absolute aging temperature. This method yields a linear graph which provides a convenient method of extrapolating high temperature data to lower temperatures.

Results and Discussions

Using such a varnish test procedure, a system for classification of the thermal stability of varnishes has been developed. In this system, the thermal aging of a typical class A varnish, identified as varnish S, was determined at several temperatures. Tables 1, 2, and 3 give detailed electrical test data obtained with this varnish after thermal aging. At each aging time, 25 electric breakdown tests are made using 5 test specimens. The average of these 25 values of electric strength expressed in volts per mil is used to construct a decay chart.

The relationship for the electric strength and the aging time for this varnish is shown in figure 4. The linear relationship for the electric strength and the aging time was established by statistical means. From this chart, the thermal life of this varnish at each temperature was determined by the number of hours required to reduce the electric strength to 300 volts per mil. This data was used to make the thermal life chart for this class A varnish shown in figure 5.

In a similar manner, a thermal aging chart, figure 6, and thermal life chart, figure 7, for a typical class B varnish were determined. This varnish has been identified as varnish M. Motor test data was also available for the two varnishes. The motor tests were conducted in accordance with AIEE 510, Test Procedure for Evaluation of Systems of Insulating Materials for Random-Wound Electric Machinery. The tests were made using five horsepower motors rated 440 volts, three phase, 60 cycle. This procedure subjects the motor insulation to thermal aging, mechanical vibration, thermal shock, normal voltage stressing, and humidity throughout the testing period. These tests were performed with identical insulation systems in all the motors tested except for the insulating varnish.

The results obtained on the life of the motor insulation systems using the class A and class B varnishes are compared with the life of these varnishes as predicted by the varnished glass cloth tests using the electric breakdown procedure. These results are shown in figure 8.

In the AIEE 510 test procedure, 5000 hours of life is used as the criterion for classification rating. On this basis, the life versus temperature line had a temperature value of 105°C at 5000 hours for the system using varnish S. At 5000 hours life, the temperature value was 130 degrees C for the system using varnish M. These temperature values correspond to class A and class B classification ratings.

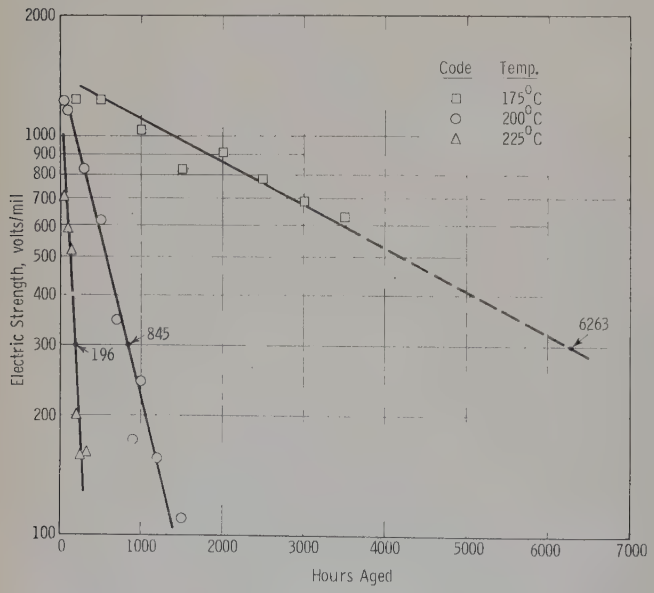


Figure 16, effect of aging on electric strength of glass cloth coated with varnish H.

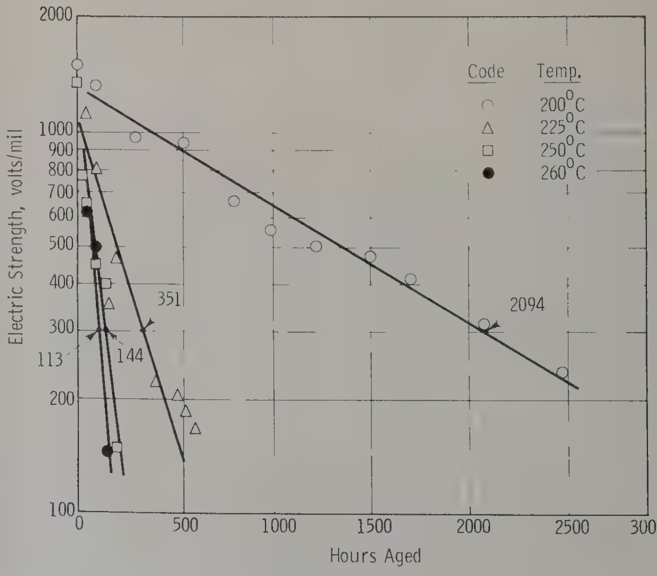


Figure 17, effect of aging on electric strength of glass cloth coated with varnish I.

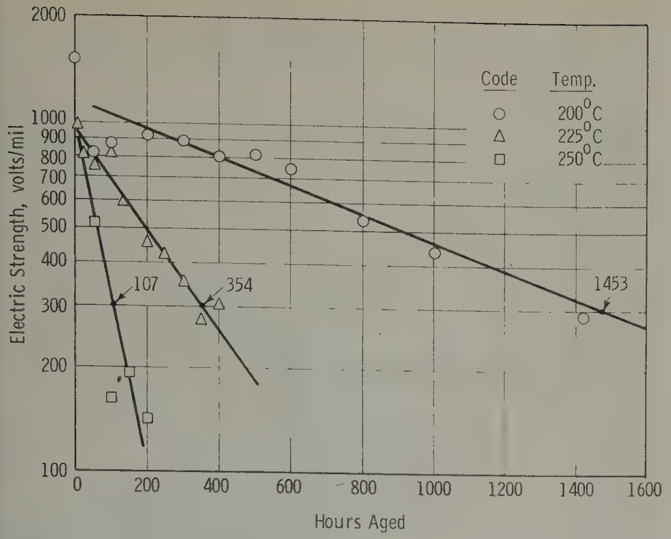


Figure 18, effect of aging on electric strength of glass cloth coated with varnish J.

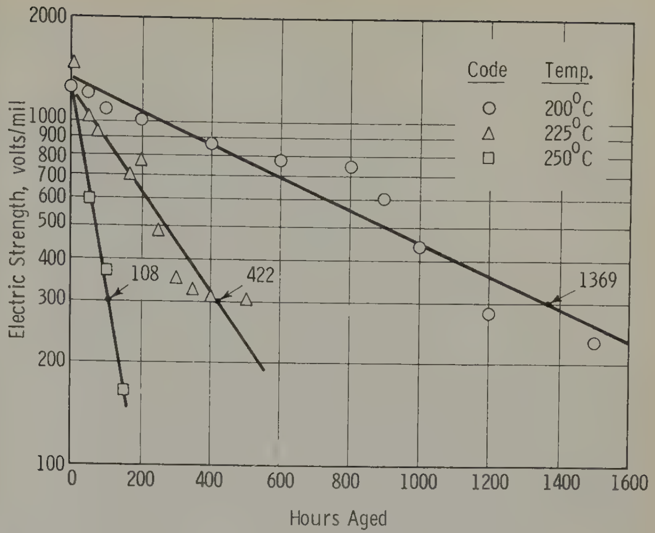


Figure 19, effect of aging on electric strength of glass cloth coated with varnish K.

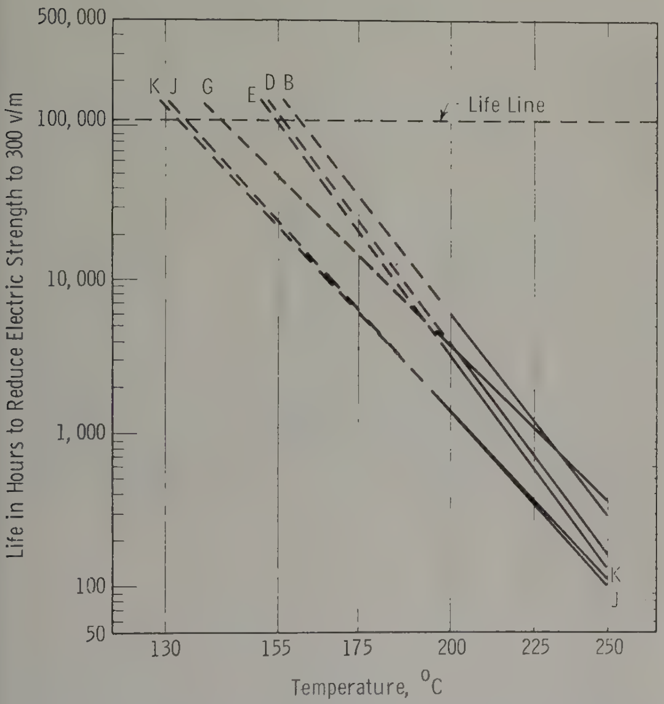


Figure 20, thermal life charts for six commercial insulating varnishes obtained by the ASTM electric breakdown procedure.

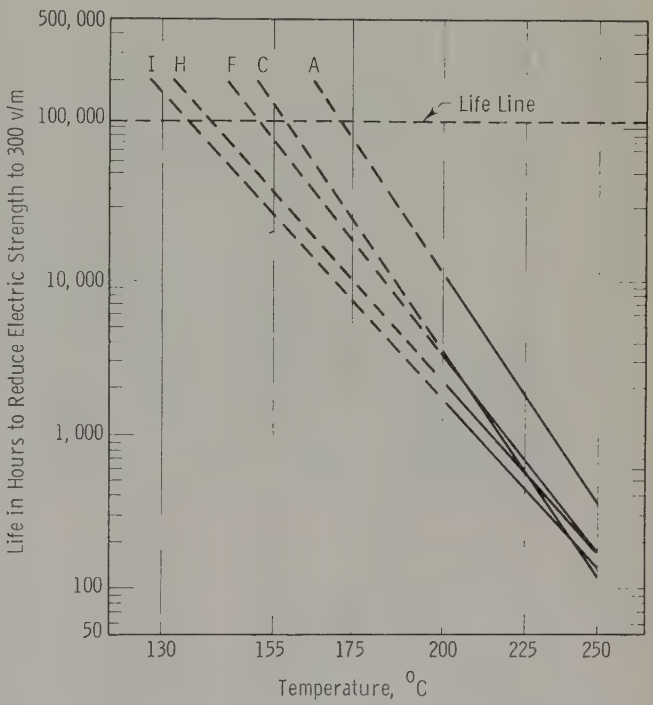


Figure 21, thermal life charts for five commercial insulating varnishes obtained by the ASTM electric breakdown procedure.

Class A varnish S tested for thermal stability by the electric breakdown procedure had a predicted life of 110,000 hours at a temperature of 105°C (class A). The extrapolated straight line for varnish M as determined by the ASTM breakdown procedure crossed the 110,000 hour life line at a temperature of 137°C.

These results show a good correlation between the two tests. The AIEE 510 test procedure gives a lower life rating, since this is a more severe test, subjecting the insulation to conditions of high humidity, multiple thermal shock, and vibration. The ASTM breakdown procedure is a much milder test, subjecting the insulation only to thermal aging, single flexing, and single heat shock.

From these results, it was decided to adopt the 110,000 hour line as the life line for classification of varnishes. Varnish life lines which cross the 110,000 life line between 105°C and 130°C would be classified as class A varnishes; those that cross between 130°C and 155°C would be classified as class B, and those that fall between 155°C and 180°C on the 110,000 life line would be classified as class F.

Figures 9 to 19 show the decay in electric strength of the 11 commercial class F varnishes when aged at several temperatures. The plotted points in these figures represent the average of 25 test values. The straight lines were calculated by means of a statistical technique called linear regression. To save time, the thermal aging data was processed on an IBM No. 704 computer.

Table 6—Predicted Life of Several Commercial Varnishes Based on the Calculated Relations Between Log of Life and Reciprocal of Temp. in Degrees Kelvin

Varnish	Life in Hours	Temperature °C
A	110000	171
	87600	174
	1900	225
	383	250
	211	260
B	110000	160
	87600	163
	5960	200
	1220	225
	291	250
	170	260
C	110000	157
	87600	160
	4070	200
	767	225
	170	250
	96.5	260
D	110000	158
	87600	160
	3480	200
	598	225
	122	250
E	110000	155
	87600	158
	3270	200
	608	225
	133	250
F	110000	151
	87600	153
	3280	200
	726	225
	185	250
G	110000	143
	87600	146
	3930	200
	1160	225
	385	250
H	110000	140
	87600	142
	5910	175
	952	200
	184	225
I	110000	135
	87600	138
	1753	200
	480	225
	149	250
	96	260
J	110000	135
	87600	138
	1430	200
	364	225
	106	250
K	110000	133
	87600	136
	1440	200
	381	225
	114	250

The relationship between electric strength and aging time is expressed as:

Log electric strength in volts/mil=a+b (aging time in hours). The calculated constants *a* and *b* for the 11 varnishes for the different aging temperatures are listed in table 2. These values were used to establish the straight lines in figures 9 to 19.

Table 7—Classification of Several Varnishes Using the ASTM Curved Electrode Electric Breakdown Procedure

Varnish	110,000 Hours Life Line-Temp. °C	Rated Class
A	171	F
B	160	F
C	157	F
D	157	F
E	155	F
F	151	B
G	143	B
H	140	B
I	135	B
J	135	B
K	133	B
M	137	B
S	105	A

The predicted life of the 11 varnishes based on the calculated relationship between aging time and logarithm of electric strength is given in table 3. Included in the table are also the 95 percent confidence limits and standard deviation. The predicted life is the aging time required to reduce the electric strength to a level of 300 volts per mil.

It was shown previously that the logarithm of the time to reach a certain point of deterioration was proportional to the reciprocal of the absolute temperature.[2] Such a linear graph provides a convenient method of extrapolating high temperature data to low temperatures. Thermal life charts, figures 5 and 7, are based on this relationship.

Figures 20 and 21 are similar thermal life charts for the 11 commercial class F varnishes. These charts were constructed using the calculated data listed in table 6.

Using 110,000 hours as the criterion for classification rating, the results obtained for the 11 commercial varnishes are shown in table 7. Of the 11 varnishes tested, only 5 can be rated as class F (155°C), while the other 6 are in the class B range (130-155°C).

Conclusions

The ASTM curved electrode breakdown procedure has been found to be a good screening test for evaluation of the thermal stability of varnishes. Other methods of handling the test data may also be found suitable, but the particular system adopted here was found very convenient.

The criteria for classification of the thermal stability of varnishes are based on a reasonable correlation between the breakdown test and the AIEE 510 motor test which is a functional type test.

Some of the varnishes tested were found to have suitable thermal stability to be considered for class F applications. Six of the varnishes were found to be lacking in sufficient thermal stability and would only be considered for class B applications.

The wide difference found in the thermal stability of the 11 varnishes indicates the need for the thermal stability evaluation of varnishes. The method of procedure adopted here may aid varnish suppliers in fulfilling this need.

References

1. "Thermal Life of Varnished Glass Cloth," C. J. Straka and E. W. Lindsay, AIEE Transaction No. 47, April, 1960, pp. 58-64.
2. "Electrical Insulation Deterioration Treated as a Chemical Rate Phenomenon," T. W. Dakin, AIEE Transaction Vol. 67, Part 1, 1948, pp. 113-118.

Your profits suffer for the pennies you pinch on printed circuits

Normally, the cost of the copperclad laminate in a printed circuit is peanuts compared to the cost of the product in which it is used.

So whether you produce your own boards, or buy them already punched and etched for assembly, a review of the specific laminates you are now using could uncover an important new benefit.

Perhaps a dollar benefit . . . fewer rejects due to poor cold-punching qualities, unsatisfactory foil bond strength, poor dip soldering performance, or dimensional instability. Or perhaps dollars saved in reduced servicing of circuit failures in installed equipment. Keep in mind, the laminate is only a fraction of your loss.

You might turn up a new product benefit. Greater reliability, and assurance for your customer that your equipment will measure up to the trouble-free performance he expects. Maybe you will find that a *flame retardant* printed circuit will give your product a selling edge, or reduce the danger of fire and severe damage to expensive equipment.

Start a review of your copperclad laminates with a call to the nearby NVF Sales Office, or write for samples and literature. Dept. D-9, Wilmington, Delaware.

116 Choices: One Source This is the latest count of the different plastics and grades NVF can offer in your search for the *one best material.* Add to this total *the* one special grade that can be developed from scratch to meet your particular need. This full range of materials is backed by complete engineering services . . . from application assistance up to and including the delivery of 100% usable, precision-fabricated parts . . . in any quantity, on time!

Call the NVF Sales Office near you. It's a direct line to single-source help on your current materials problem.

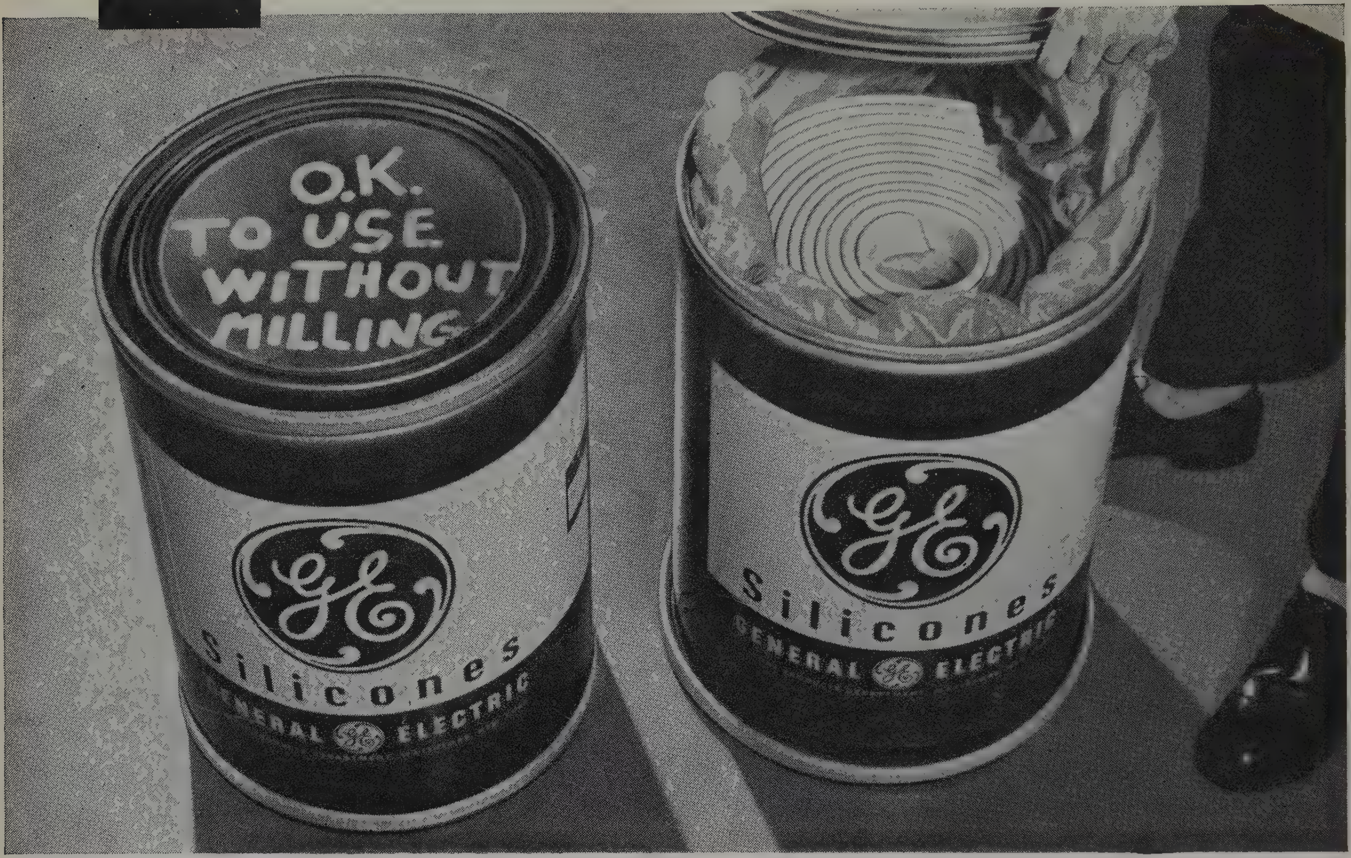
NATIONAL VULCANIZED FIBRE COMPANY
WILMINGTON 99, DELAWARE
In Canada: NATIONAL FIBRE COMPANY OF CANADA, LTD., Toronto 3, Ontario

Print Ins. 13 on Reader Service Card

SILICONES

Three months on the shelf...

YET NEW SE-9008 SILICONE RUBBER WIRE AND CABLE COMPOUND CAN STILL BE USED WITHOUT MILLING!



General Electric's non-milling silicone rubber compound SE-9008 is the *only* quality wire and cable compound you can buy that keeps freshened life *for three full months!* You can now cut way down on your processing costs, and provide wire and cable with high performance capabilities at moderate cost.

SE-9008 comes in coiled "hats" ready to feed *automatically* into your extruder. No pre-milling, no modifications, no special dies required.

Strips comes 2″ wide, and either ½″ or ¼″ thick, whichever you require. Available for either hot air or steam vulcanization.

SE-9008 is excellent for power cable, fixture wire, motor and apparatus wire, and other commercial and military applications.

SE-9008 is moderately priced, and possesses good electrical and physical properties. Meets Underwriters Laboratory requirements for silicone rubber insulated fixture wire.

SE-9008 is another cost-saving product from General Electric, who supplies more silicone rubber for wire and cable insulation than all the other suppliers *combined!*

For more information on SE-9008, write: General Electric Company, Silicone Products Department, Section M951, Waterford, New York.

GENERAL ELECTRIC

Print Ins. 14 on Reader Service Card

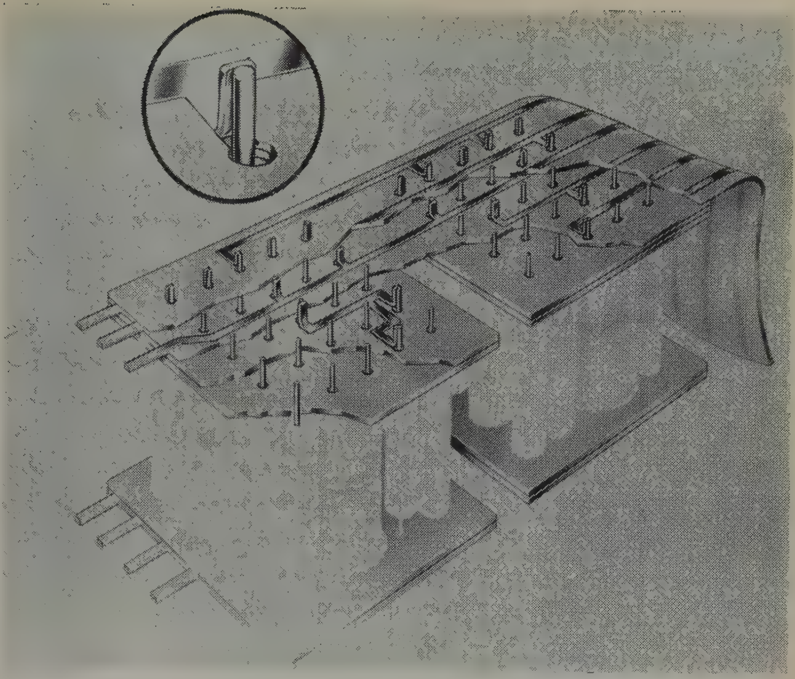


Figure 1, diagram of "Intercon" wiring circuit produced by Amphenol-Borg Corp. used in electronic miniaturization, illustrates flexibility and need for high peel strength epoxy adhesive that maintains bond of circuitry to insulating board. High dielectric strength prevents short circuits.

Case Histories Point Up High Strength, Heat Resistance, and Electrical Properties of Epoxies

40 Lbs/Inch Peel Strength for Flexible Printed Circuit, Mechanical and Heat Shock Resistance for Magnetic Clutch

By H. B. Heinzen, Epic Resins Corp., Waukesha, Wis.

Two case histories . . . one electronic, one electrical . . . emphasize the versatility and design possibilities of recently developed epoxy compounds.[1] In one case an epoxy is used for bonding flexible printed circuitry which must withstand the environmental extremes involved in missile flight. In another, an epoxy is used to simplify assembly and provide resistance to rugged mechanical and thermal abuse in a magnetic clutch. Electrical insulation properties were also important in both instances.

Advantages reported for the epoxies include high cohesive and adhesive strengths with optional flexibility or rigidity. In addition, the epoxies have mix ratios which are non-critical—equal amounts of hardener and filler may be added in small or large quantities to achieve different end results. Also, the formulating and compounding process used in making the compounds precludes settling of fillers. Other features cited are high dielectric, physical strength, and chemical resistance properties. Viscosity can be altered to make the epoxies suitable for adhesives, dip coatings, and potting compounds.

Tough Printed Circuit Application in Missiles

The Packaged Electronics Division of Amphenol-Borg Electronics Corp. produces electronic circuitry known as "Intercon," a packaged circuit design that projects conductor ends into the third dimension for greater ease of wiring in miniaturized applications. The printed circuit board requires an epoxy adhesive that must withstand three demanding conditions:

1. Flexing of board without breaking the bond of the circuitry. (In actual practice, the board might be flexed a maximum of 4 or 5 times during fabrication—however, a prototype board was flexed 120° for 25 times with no loss of bond.)
2. Wide range of temperature changes that are inherent in missile flight.
3. Desirable electrical insulation.

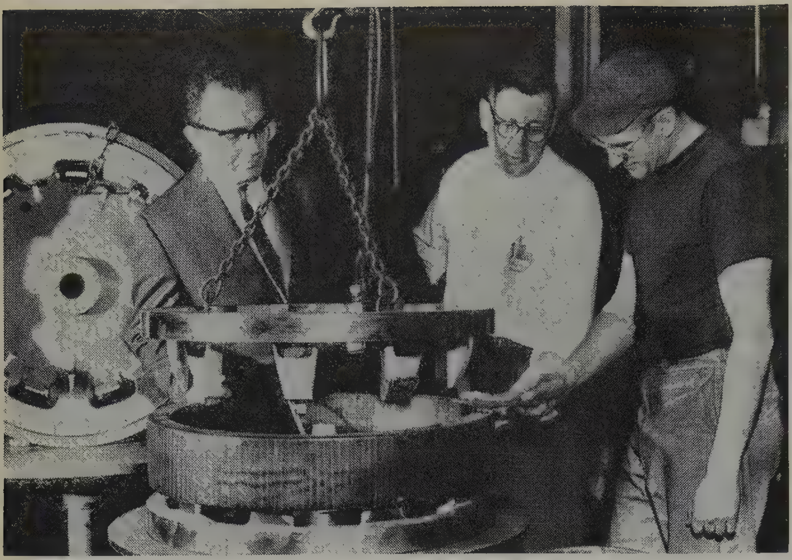


Figure 2, H. B. Heinzen, Epic Resins Corp., and Walter Kugland, Harnischfeger Corp., watch Elroy Jeske demonstrate the application of epoxy to taped electrical coil. The upper and lower metal toroids are heated prior to assembly of the three components. No further processing is needed before finishing operations in the machine shop.

Amphenol-Borg conducted tests to determine the ability of various materials to meet the requirements of the first condition. To test these qualities, the epoxy was peeled away from the printed circuit board. Other epoxy bonds broke at four to eight pounds per inch of width but the new epoxy required in excess of forty pounds to effect a separation.

Examination of the photo graphically illustrates the great flexibility demanded in the Intercon circuitry, a flexibility which the company previously had found impossible to attain.

The new resin also provided high dielectric properties (see electrical data at end of article) which permitted the use of several boards in close proximity without danger of short circuiting. These insulating qualities had to be maintained over a temperature range of —55° to +100°C.

Other Intercon circuitry requirements include:

1. High chemical and moisture resistance.
2. Stability over long periods.
3. Consistent maintenance of product quality from batch to batch.
4. Fast cure with heat.
5. Long pot life of mixed components.
6. Non-toxic to plant personnel.

Successful in Magnetic Clutch of Excavator

The Harnischfeger Corp. of Milwaukee has used the new epoxy in the assembly of their magnetic clutches for excavators. According to Dr. Jack Wilson of Harnischfeger, the requirements were rigid in that the epoxy had to withstand both mechanical shock and temperatures ranging between —40°C to +110°C, while at the same time maintaining satisfactory dielectric properties. Great bond strength between the iron and taped electrical coil was of prime importance.

Use of the resin permitted an estimated 10% saving in assembly time by elimination of extra assembly and production delays. A comparison of the two methods follows:

Former Method	*With New Epoxy*
1. Coil wrapped with insulating tape.	1. Coil wrapped with insulating tape
2. Spacers placed between coil and metal toroids.	2. Epoxy applied to all of coil surfaces.
3. Adhesive applied to outside of coil.	3. Encapsulated coil placed between two preheated toroids which effect the cure.
4. Unit assembled.	4. Unit sent to machine shop for finishing operation.
5. Varnish dipped and oven cured for several hours.	
6. Unit sent to machine shop for finishing operation.	

Two important advances were possible with the new resin:

1. The "creep" between coil and toroid which sometimes occurred with the former method was completely eliminated.
2. The varnish dip and oven cure which formerly necessitated extra production time was eliminated.

Other advantages cited by Harnischfeger Corp. included:

1. The mix ratio of the new epoxy is non-critical with the percentage of filler in the resin and the hardener being identical. Fillers are vital to achieve good adhesion so this balance allowed variation in mixing ratios without affecting adhesive qualities.
2. Easy application of the mixed resin permits current plant personnel to make the assembly without use of special equipment.
3. Mixed adhesive stays in place even under the high temperatures of the pre-heated toroids (121°-149°C).
4. Cure schedule (30 minutes) fits in nicely with material flow eliminating production bottle-necks.

Typical Processing and Property Information

Typical processing information and property data follow:

Mix Ratio

The epoxy adhesives have non-critical mix ratios ranging from 50 parts of hardener per 100 parts of resin to 200 parts of hardener per 100 parts of resin. No weighing is necessary. The end usage determines in what range the resin-hardener ratio should be.

Pot Life

The mixed pot life is:

½ lb Batch—2½ Hrs.
1 lb Batch—1¾ Hrs.
5 lb Batch—1 Hr.

Both resin and hardener have a warranted shelf stability for a minimum of one year (unmixed).

Cure

Temperature	*Time*
65°-70°F	4- 7 Days
70°-75°F	12-16 Hours
100°F	4-6 Hours
150°F	1½-2 Hours
200°F	45 Minutes
300°F	15 Minutes

Hardness

Resin-Hardener Ratio	*Hardness*
100-70	Barcol 64
100-100	Barcol 24
100-150	Shore A 90
100-200	Shore A 75

Higher hardener ratios than those indicated result in softer material; however, moisture resistance is reduced.

Tensile and Shear Strengths (Resin-Hardener Ratio 100:100) Over 2500 psi before and after impact stresses of 75 inch-pounds (with ½″ diameter sphere).

Resistance to Thermal Shock (Resin-Hardener Ratio 100:100) Passes all cycles when tested in accordance with the method described in U.S. Patent 2,681,901. These cycles are:

2 Cycles at —70°C to Room Temperature

2 Cycles at 100°C to Room Temperature

2 Cycles at 150°C to Room Temperature

2 Cycles at 200°C to Room Temperature

Resistance to Solvents and Chemicals (Resin-Hardener Ratio 100:100) Ultimate tensile and shear value before testing over 3000 psi and all tests at ambient temperature.

Test Material	*% Strength Retention*
Aviation Gasoline	100%
Hydraulic Fluid	Over 90%
Hydrocarbon	100%
Isopropanol	Over 90%
SAE # 10 Motor Oil	100%
Salt Spray	Over 70%
Tap Water	Over 80%
Acid, 10% Hydrochloric	Good, tests not completed
Acid, 10% Sulfuric	Good, tests not completed

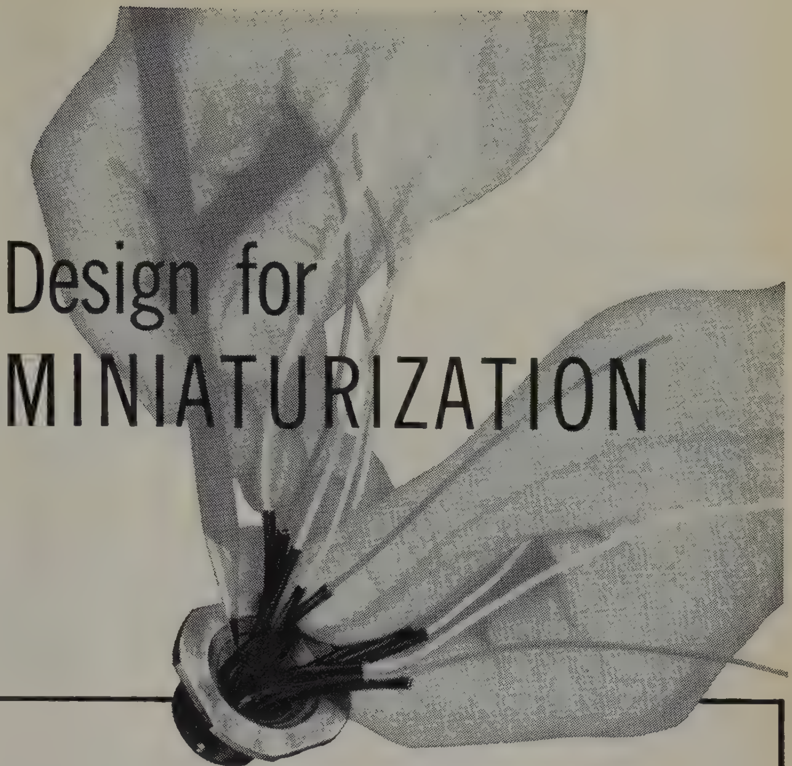
Electrical Data (Resin-Hardener Ratio 100:100)

Dielectric Strength (Step-by-step ⅛″ spec.)	450 volts/mil.
Volume Resistivity	1.3 x 10^{14} ohm/cm.
Arc Resistance	90 seconds

	60 cps	*1000 cps*	*1,000,000 cps*
Power Factor	.0088	.0105	.0190
Diel. Const.	3.28	3.22	3.04
Loss Factor	.031	.034	.063

---

[1] *Epic #4061 and 4062 epoxy compounds.*



Design for MINIATURIZATION

Thin Wall

VARGLAS Silicone Rubber **SLEEVING**

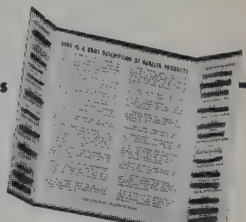
Varglas Silicone Rubber Sleeving with its space-saving thin wall construction and precision ID, is the answer for insulation in the trend toward miniaturization.

The ultimate in flexibility and dielectric strength, Varglas retains its protective properties over a wide temperature range, from minus 70° to plus 400°F. Tough and abrasion-resistant, this supported silicone rubber sleeving resists deterioration and "cut through"; will not crack or craze. Dielectric protection provided up to 8,000 volts and certified to meet government specification MIL-I-18057A.

Available in brilliant, non-fading colors for instant, easy color-coding in a complete range of sizes from .010″ to 3″ ID, and obtainable in coils or on spools as well as in individual 36″ lengths. Deliveries made promptly off-the-shelf or produced on order within one week.

Let Varflex engineers work with you in developing special types of sleeving and tubing to meet your particular specifications. No obligation.

• **WRITE FOR FREE FOLDER Containing Test Samples**



Makers of Electrical Insulating Tubing and Sleeving

Varflex

Never Satisfied Until You Are

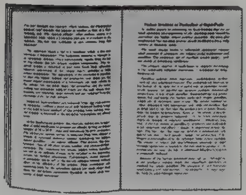
VARFLEX SALES CO., Inc. • 320 N. Jay St., Rome, N.Y.

Print Ins. 15 on Reader Service Card

That odor you smell is money escaping!

The odorous fumes coming from your plant are probably costing you much more than the good will of your employees and neighbors. For these odors often represent a wasted asset . . . a missed opportunity to lower your costs . . . through conversion of fumes to BTU's for return to your ovens, use in other plant processes, or heating plant make-up air.

Thousands of installations . . . on ovens and dryers for wire enameling, paint baking, metal decorating, paper printing and impregnating, organic coating and curing, and many other purposes . . . have proven the economy and feasibility of using objectionable oven exhaust vapors as money-saving fuels through Catalytic Combustion. In this proven process, all-metal catalysts and catalytic systems oxidize these gases by *low temperature, flameless combustion* . . . to give you usable energy and an odorless and colorless discharge. Incidental benefits often include reduced fire hazards, simplified cleaning maintenance, healthier working conditions . . . and better community relations.



For more details *on the economies possible write Dept. A for this brochure. Or, give us a few facts on your oven exhaust problem so we can make specific suggestions . . . to you, or your equipment builder.*

CATALYTIC COMBUSTION CORPORATION
4725 Fourteenth Street • Detroit 8, Michigan
A SUBSIDIARY OF UNIVERSAL OIL PRODUCTS COMPANY

Print Ins. 16 on Reader Service Card

An Evaluation of Water-Soluble Fluxes--Part 2

By F. Z. Keister, Member Technical Staff, Hughes Aircraft Co., Culver City, Cal. Part 1 appeared in the August issue.

Electrically Polarized Wire Test

These tests are designed to examine the corrosive effects of the various fluxes on polarized copper wire. Corrosion was accelerated by exposing the fluxed copper wire specimens to 95% relative humidity and 100°F and by the application of a 45-volt d-c potential. Figure 5 is a photograph of the test fixture used.

One length of 0.0026″ diameter copper wire was wrapped in a helix around the length of one glass tube. A second helical wrap of copper wire was applied to this same glass tube with the turns being parallel to, and midway between, the turns of the first helix. This procedure was repeated for each of the eight tubes. The wrapped tubes were placed on the test rack and the two loose wires at opposing ends of each tube were soldered to the respective bus bars mounted at each end of the wire-wound tubes. Flux was applied within alternate areas between the turns of the wire, so that the flux would spread and form a series of independent bridges connecting the members of alternate pairs of adjacent wires. The process was repeated using a different flux for each wire-wound glass tube. The fluxed tube assembly was then placed in a humidity chamber maintained at 95% RH and 100°F. The bus bars of the test fixture were connected to the terminals of a 45-volt dry cell. The test was supposed to continue for 30 days; however, the results were so conclusive that the test was discontinued after 117 hours.

From the examination of the glass tubes, it was observed that all of the fluxed tubes except those fluxed with flux A and flux B exhibited corrosion. In fact all of the water-soluble fluxed tubes were corroded to such an extent that, except for the hydrazine types, both of the wires were severed in several places so that electrical continuity was lost. In addition, a characteristic blue-green discoloration was observed on all tubes fluxed with the water-soluble types. A white crystalline deposit was found on the hydrazine types. The hydrazine fluxes lost continuity in only one wire; however, the intact wire showed signs of corrosion. It must therefore be concluded that all of the water-soluble fluxes failed this test.

Humidity Test

The humidity tests were designed to determine the relative corrosiveness of eight fluxes under conditions of high humidity and temperature for an extended time. For a full evaluation each flux was tested: (a) in the pure state, (b) after soldering, and (c) after soldering and cleaning.

The cleaned copper test specimens were treated as follows:

Treatment A—Apply four drops of flux (approximately 0.1 grams) to the center of the test specimen using an eyedropper. The flux was allowed to dry at room temperature.

Treatment B—Place a ¼″ diameter solder spiral of 50/50 solid wire solder in the middle of the copper test specimen. Apply four drops of flux to the solder spiral. Allow the flux to air dry. Float the copper square flatly on the surface of the molten 63/37 solder (475°F) with the fluxed solder spiral facing up. Remove the copper square from the solder pot after 10 seconds.

Treatment C—Proceed as in treatment B. After removal from the solder, clean the soldered copper square to remove flux residues.

Figure 6 is a photograph of the test specimens after exposure to high

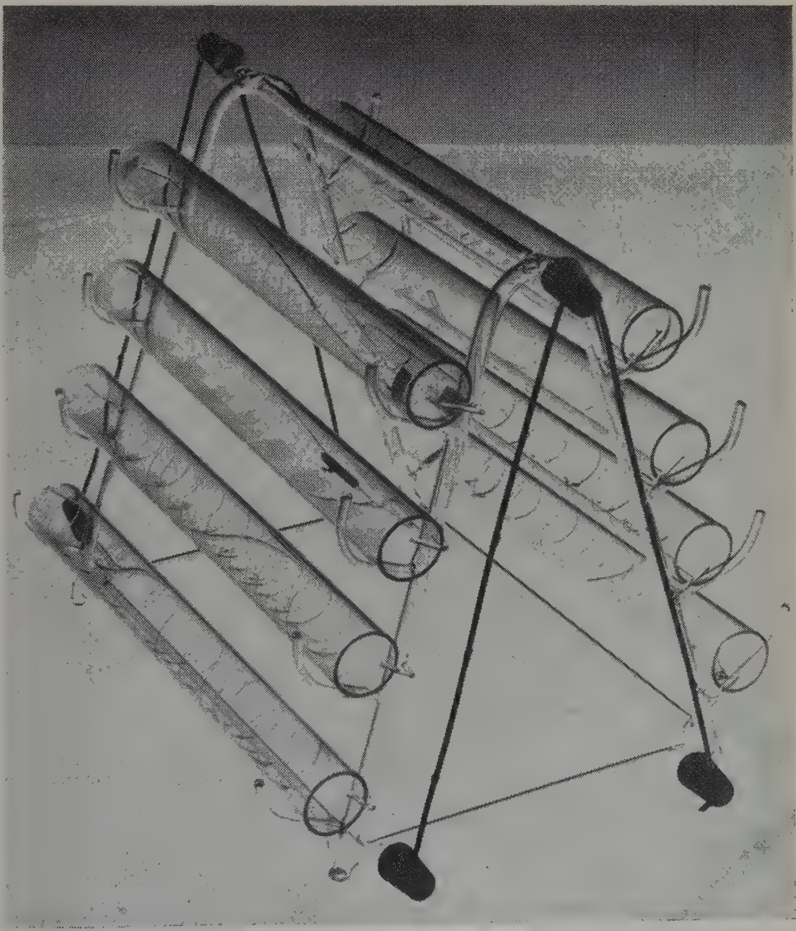


Figure 5, electrically polarized wire test fixture after conditioning.

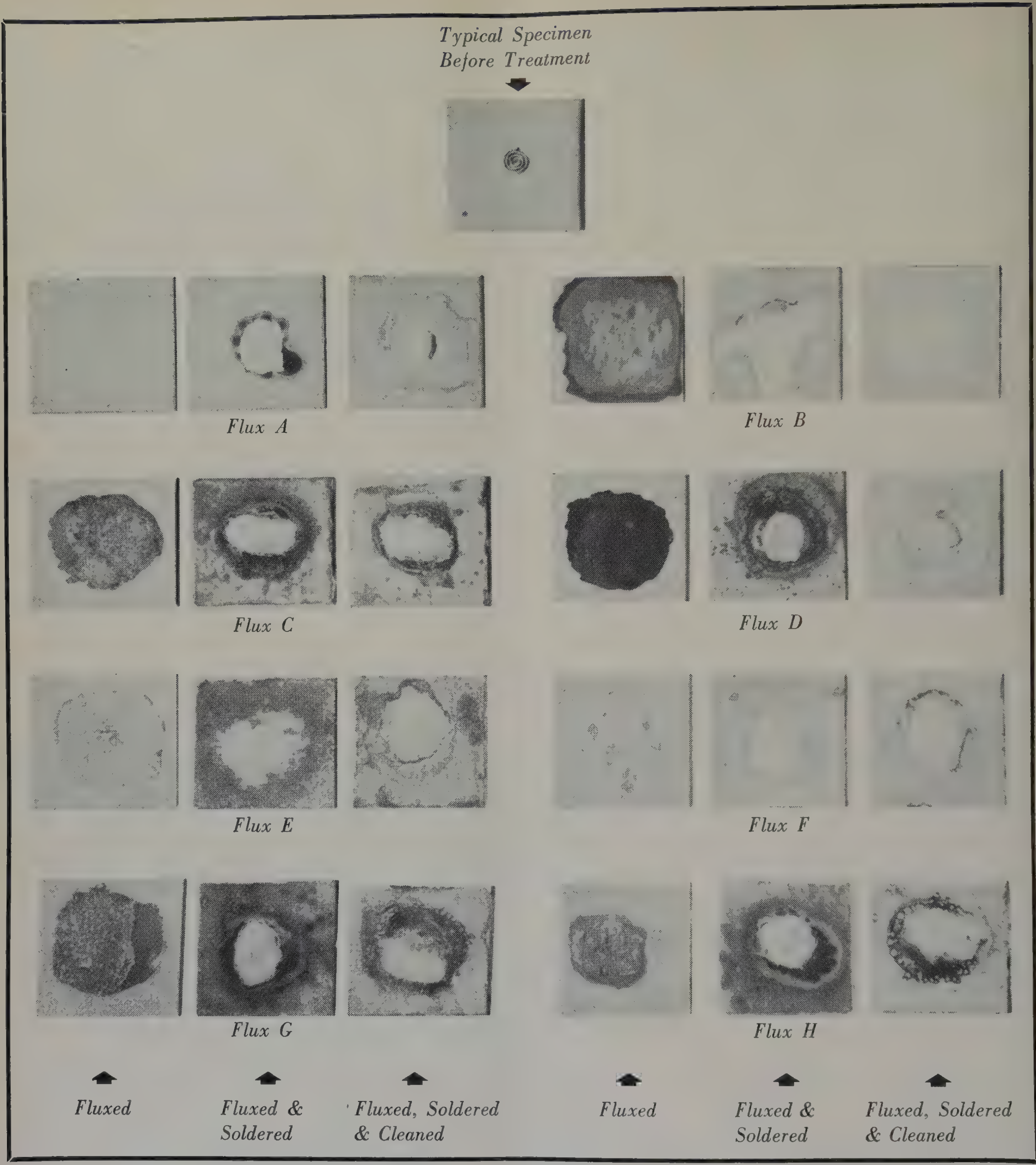


Figure 6, humidity test specimens. Appearance after 117 hours at 100°F and 95% R.H.

humidity (95% RH) and elevated temperature (100°F) for 117 hours. From a microscopic examination of the conditioned specimens, it was observed that only the rosin-base fluxes did not cause corrosion of the copper regardless of the treatment of the copper test specimen. Using a strict interpretation of the test results, only the rosin-base fluxes can be considered as passing since the military specifications mention only treatment A as a criterion. Considering only the water-soluble fluxes, fluxes E, F, and H were not corrosive when given treatment C. All of the water-soluble fluxes exhibited corrosion under treatments A and B. Fluxes C, D, and G were extremely corrosive under treatment A.

Fluxing Action Test

The purpose of the fluxing action test was to determine the relative activities of the fluxes under test and to observe how they promote "wetting" of a clean copper surface by solder. It also enables an evaluation of the amount of sputtering or splattering of the flux under question and the quality and appearance of the soldered surface. The solder should spread over the fluxed copper surface and form a bright, non-porous coat which feathers out to a thin edge. The same type of test specimens and pancake solder spirals as were used in the humidty tests were employed in these tests.

One pancake solder spiral was placed in the middle of each copper test specimen and four drops of flux were applied to the center of each solder spiral using an eyedropper. Before the flux had a chance to dry, each fluxed copper test specimen was floated horizontally on the surface of a solder pot for 7 seconds. Any solder splattering was observed. The soldered test specimen was removed from the solder pot and allowed to cool. The physical appearance of the solder pool was noted. The average height of the solder pool above the copper surface on each test specimen was measured.

The results of the fluxing action tests are given in table IV. All of the water-soluble fluxes were satisfactory from the standpoints of a bright, non-porous coat and adequate feathering. Fluxes B, E, and F exhibited superior flowing action. Strictly speaking, all of the fluxes can be considered as having passed this particular test.

Spread Factor Test

The purpose of the spread factor test was to determine the comparative abilities of each of the fluxes to promote the spreading and flowing of molten solder over a badly oxidized copper surface. This test differs basically from the fluxing action test in that an *oxidized* rather than a *clean* copper surface was used. In addition, a solder loop rather than a pancake solder spiral was used in this test.

Copper test specimens were oxidized by baking for 1 hour at 205°C in a circulating air oven. A solder loop was placed in the center of each of the oxidized copper test specimens and 5 drops of flux were placed in the center of each solder loop. The fluxed test specimens were then placed on a flat level steel plate in an oven maintained at 205°C. After 6 minutes the copper test specimens were removed from the oven and excess flux residues were removed. The average height of the melted solder loop above the copper surface was measured to the nearest 0.001 cm. The calculation of the spread factor was made as follows:

(a) Calculate the volume, V, of solder in one loop.

(b) The diameter, D, of an equivalent sphere is then $1.2407 \times V^{1/3}$.

(c) The spread factor is $(D\text{-}H) \cdot 100/D$ where H is the average measured height of the loop.

Figure 7 is a photograph of some of the spread factor test specimens after the solder loop has been melted in the oven. Table V gives the actual numerical values of the solder spot heights and the calculated spread factors. A spread factor in excess of 80 was considered as passing this particular test. From figure 7 it is visually evident that the rosin-base fluxed specimen did not wet the oxidized copper surface to any great extent. In fact the rosin-alcohol sample did not spread, but rather formed two small solder balls. Flux B formed two discontinuous solder lumps. From table V we note that all the fluxes except pure rosin-alcohol (flux A) passed this test. As expected, the water-soluble fluxes had better spreadability than the rosin-base fluxes. Flux C had the best spreading qualities of all the fluxes tested. It must also be recognized that flux C also left the greatest amount of corrosive residue.

Copper Mirror Test

Of all the testing methods for fluxes, the copper mirror is perhaps the most rapid and sensitive method of evaluating corrosivity. It basically evaluates the rate and extent at which a given amount of flux will etch a thin deposit of copper from a flat glass surface. Copper mirrors were made by vacuum depositing (5×10^{-5} mm. of Hg) pure copper on glass microscope slides from a molybdenum boat to a thickness of approximately 500 A°.

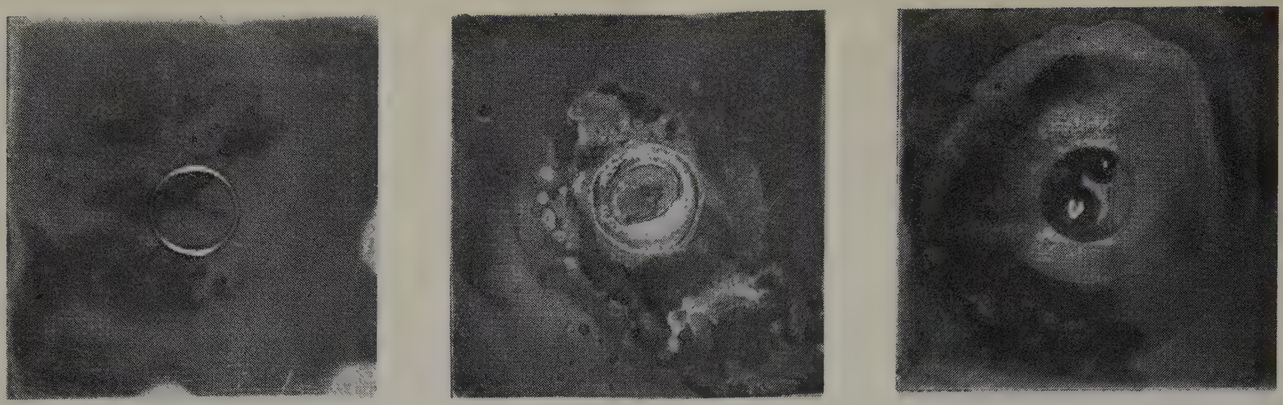
One drop of flux was placed on each of seven copper mirrors and two drops of flux were placed on each of eight more mirrors. After a 24-hour storage period at room ambient, each copper mirror was examined and the visual appearance and amount of cor-

Table IV—Fluxing Action Test Results

Flux	Avg Height of Solder Spot (cm)
A	0.01472
B	0.00710
C	0.00922
D	0.00972
E	0.01035
F	0.00755
G	0.00995
H	0.00905

Table V—Spread Factor Test Results

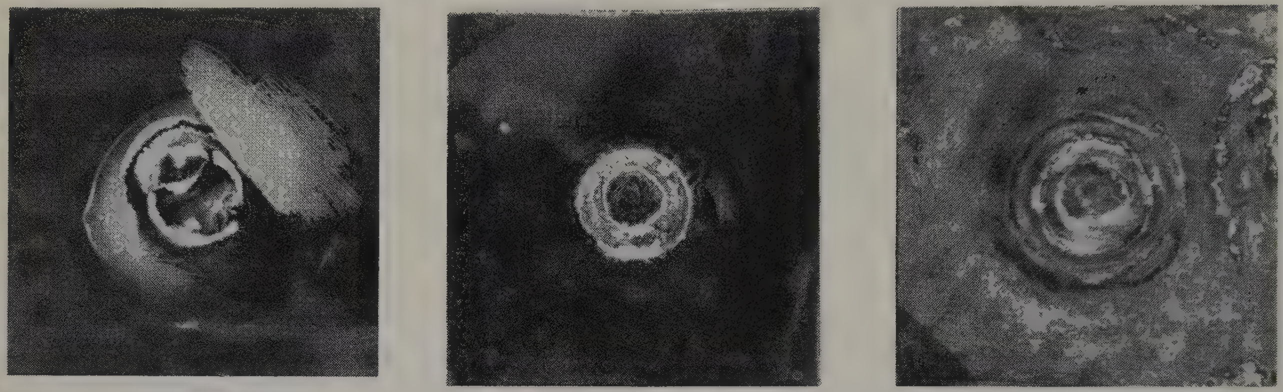
Flux	Avg Height of Solder Spot (cm)	Calculated Spread Factor
A	0.2123	35
B	0.0619	81
C	0.0360	89
D	0.0414	87
E	0.0381	88
F	0.0478	85
G	0.0371	88
H	0.0404	88



Typical Specimen Before Treatment

Flux D

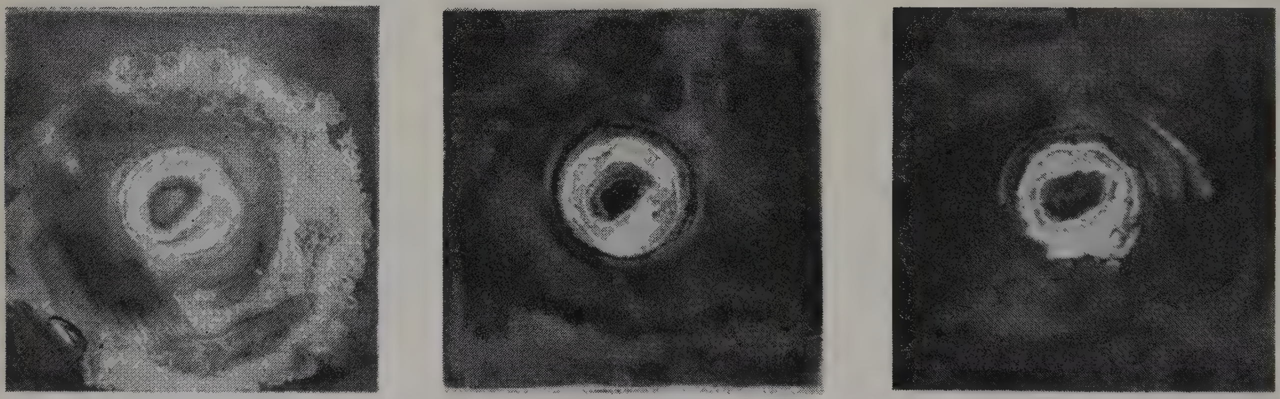
Flux A



Flux B

Flux C

Flux E



Flux F

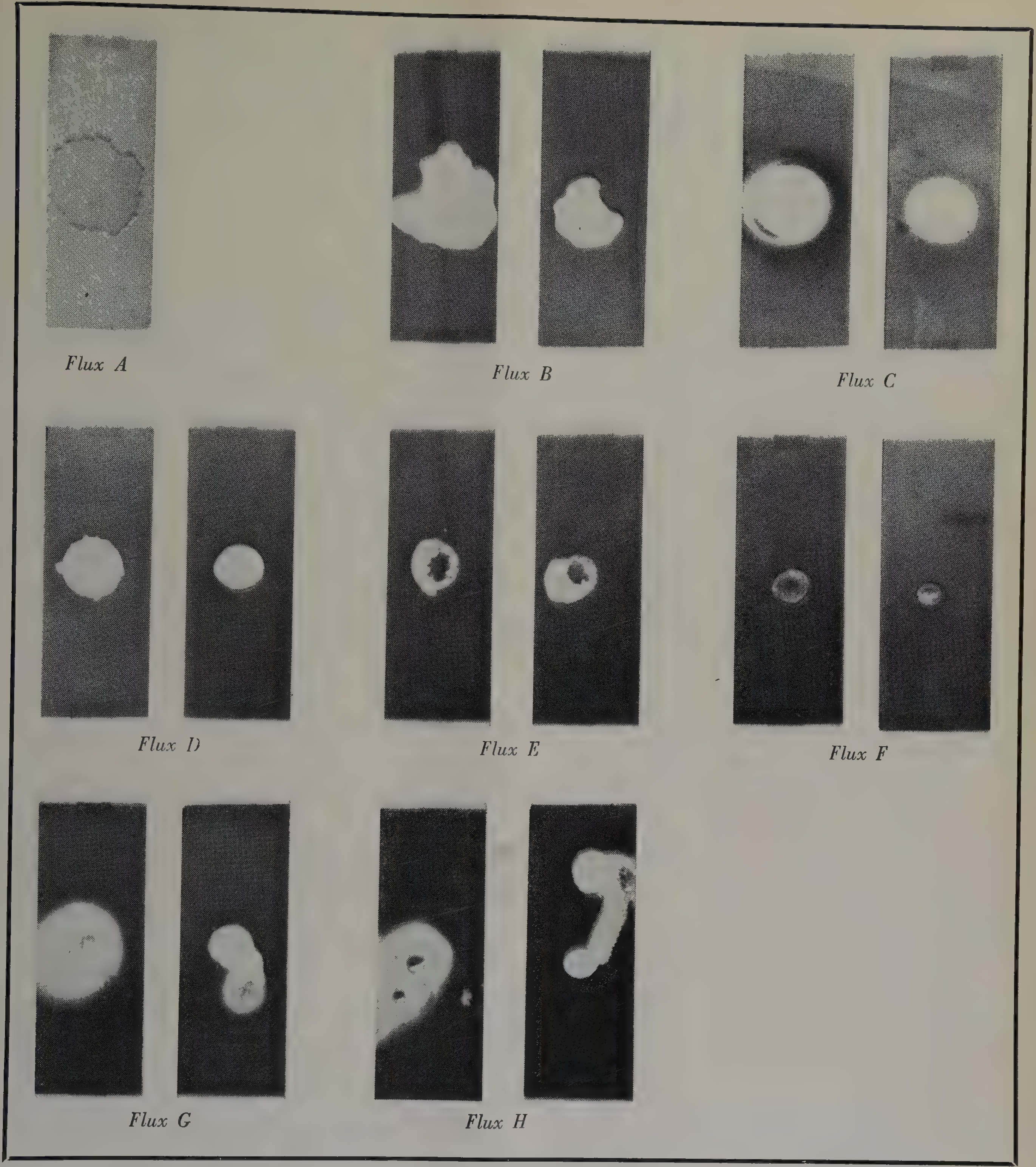
Flux G

Flux H

Figure 7, spread factor test specimens.

rosive attack was noted. Figure 8 is a photograph of the 15 copper mirrors. The left-hand mirror of each pair is that mirror on which 2 drops of flux were applied. The right-hand mirror was fluxed with only one drop of flux. The rosin-alcohol mirror (flux A) had two drops of flux applied to it.

Using rosin-alcohol as a standard of comparison, all of the fluxes except rosin-alcohol would be considered as failing this test. However, since flux B is primarily used for production etched circuit soldering, it is more realistic to consider as failing those fluxes exhibiting more corrosion than flux B. In this respect, fluxes C, D, G, and H are the only fluxes which failed. Progressive corrosion occurred on those copper mirrors fluxed with fluxes C, G, and H and to a slight extent with fluxes D and E. Rosin-alcohol was non-corrosive and flux H was the most corrosive. It should be noted that the hydrazine-base fluxes showed less corrosivity than the acti-



Flux A

Flux B

Flux C

Flux D

Flux E

Flux F

Flux G

Flux H

Figure 8, copper mirror test slides. Appearance after 24 hours at room ambient.

vated rosin-alcohol flux (flux B).

Twisted Wire Test

This test has also been termed a "capillary rise" test and its purpose is, in fact, to measure the height to which molten solder rises by capillarity along a pair of twisted wires. This height is then taken as a measure of the fluxing ability of the particular flux being investigated.

Two gold plated copper wires are twisted together on an approximate 1″ pitch and the assembly is then inserted through a cork. The cork is fitted into one end of a Pyrex glass tube and the twisted pair is adjusted so that ¼″ of wire extends below the opposite end of the tube. Refer to figure 9. The wire-cork assembly is fluxed for the entire length of twisted wire by dipping and allowed to air dry for 15 minutes. The assembly is then dipped vertically into a solder bath so that the end of the glass tube is level with the top of the solder bath and the height to which the solder has risen along the twisted wires is measured.

The results of the twisted wire test are shown in table VI. The measurements recorded include the length of twisted wire extending below the tube plus the height to which solder was drawn up the twisted wire pair by capillarity. Flux H exhibited the greatest solder rise and flux A the least rise.

Flow and Consistency Test

The purpose of this test was to determine the consistency, stability, or homogeneity of the fluxes at reasonably low (5°C) and high (45°C) temperature levels by examining drops of pure flux exposed to these conditions for a minimum of one hour.

No separation of any of the flux constituents was noted at either 5°C or 45°C. At 5°C all the fluxes were easily drawn up by an eyedropper. All eight fluxes passed this test.

Acid Number Test

The purpose of this test was to determine the comparative acidity of the eight fluxes under investigation. This was done by weighing out approximately 100 ml of denatured alcohol (neutral to phenolphthalein). The flux-alcohol solution was titrated with 0.1 N alcohol potassium hydroxide using a phenolphthalein indicator to first definite pink. The acid number was calculated as follows:

$$\text{Acid number} = \frac{\text{ml of KOH x normality of KOH x 56.1}}{\text{weight of sample x solids content}}$$

The results of the acid number test are given in table VII. As expected, the two rosin-base fluxes had approximately the same acid number, while the water-soluble fluxes were much higher in acidity. Considering an acid number within the range of 145 - 175 as passing, all the water-soluble fluxes failed this test.

Dryness Test

The purpose of this test was to determine the dryness of the residual flux one-half hour after soldering and before the application of any cleaning solvents.

A soldier spiral was placed in the center of a copper test specimen and four drops of flux are applied and allowed to dry. The fluxed test specimen was floated on the top of a solder

Table VI—Twisted Wire Test Results

Flux	Avg Height of Solder Rise (inches)
A	0.328
B	0.656
C	0.953
D	0.766
E	0.906
F	0.797
G	0.938
H	1.031

Table VII—Acid Number Test Results

Flux	Acid Number
A	149.5
B	149.4
C	356.3
D	265.9
E	456.6
F	510.5
G	493.3
H	506.2

Table VIII—Test Summary

Test	Flux							
	A	B	C	D	E	F	G	H
Solder Dipping	F-8	F-7	P-1	P-3	P-4	F-6	P-5	P-2
Insulation Resistance—30 Day	P-1	P-3	F-8	F-7	P-5	P-2	P-4	P-6
Insulation Resistance—24 Hour	P-1	P-2	F-4	F-4	F-5	F-5	F-3	F-4
Copper Mirror	P-1	P-4	F-6	F-5	P-3	P-2	F-7	F-8
Humidity	P-1	P-2	F-7	F-8	F-4	F-3	F-6	F-5
Electrically Polarized Wire	P-1	P-1	F-4	F-4	F-3	F-2	F-4	F-4
Fluxing Action	P-8	P-1	P-4	P-5	P-7	P-2	P-6	P-3
Spread Factor	F-8	P-7	P-1	P-5	P-3	P-6	P-2	P-4
Twisted Wire	F-8	P-7	P-2	P-6	P-4	P-5	P-3	P-1
Dryness	P-1	P-1	P-1	F-2	P-1	P-1	P-1	F-2
Acid Number	P-2	P-1	F-4	F-3	F-5	F-8	F-6	F-7
Flow and Consistency	P-1	P-1	P-1	P-1	P-1	P-1	P-1	P-1

bath for 7 seconds. One-half hour after soldering, powdered chalk is dusted onto the surface of the residual flux on the copper test specimen. Using light strokes of a small brush, an attempt is made to remove the powdered chalk from the surface of the flux.

Powdered chalk was easily removed from all the fluxed and soldered test specimens except those fluxed with flux D and flux H. This indicates that these surfaces were still tacky one-half hour after soldering.

Conclusions

Table VIII summarizes all the tests conducted and shows which of the tests were passed or failed by each of the eight fluxes. A "P" indicates that a particular flux passed a particular test and "F" indicates failure of that test by the flux under question. The tests are listed in order of their importance. In addition, table VIII also summarizes the test results in a qualitative manner. Each flux has been rated according to how well or how poorly it fared on each particular test. The number "1" means that this flux was rated best on this test and the number "8" indicates that this flux was the least favorable.

From table VIII we note that the water-soluble fluxes gave superior soldering and fluxing ability results, while pure rosin-alcohol and activated rosin-alcohol were outstanding from a corrosion and insulation resistance standpoint. Thus, as it turns out, the most corrosive fluxes produced the best solder joints. A happy medium between soldering ability, insulation resistance, and corrosivity must be reached. Analyzing the test results we can immediately eliminate fluxes A, C, and D from the final analysis. Pure rosin-alcohol (flux A) is certainly unsuitable for solder dipping applications, while fluxes C and D are too corrosive and electrically conductive to be trusted in military electronic equipment where the delicate nature of the assemblies prevents extensive flux residue removal procedures. Of course, with ultrasonic or other equally good cleaning methods, these more active fluxes might certainly be applicable.

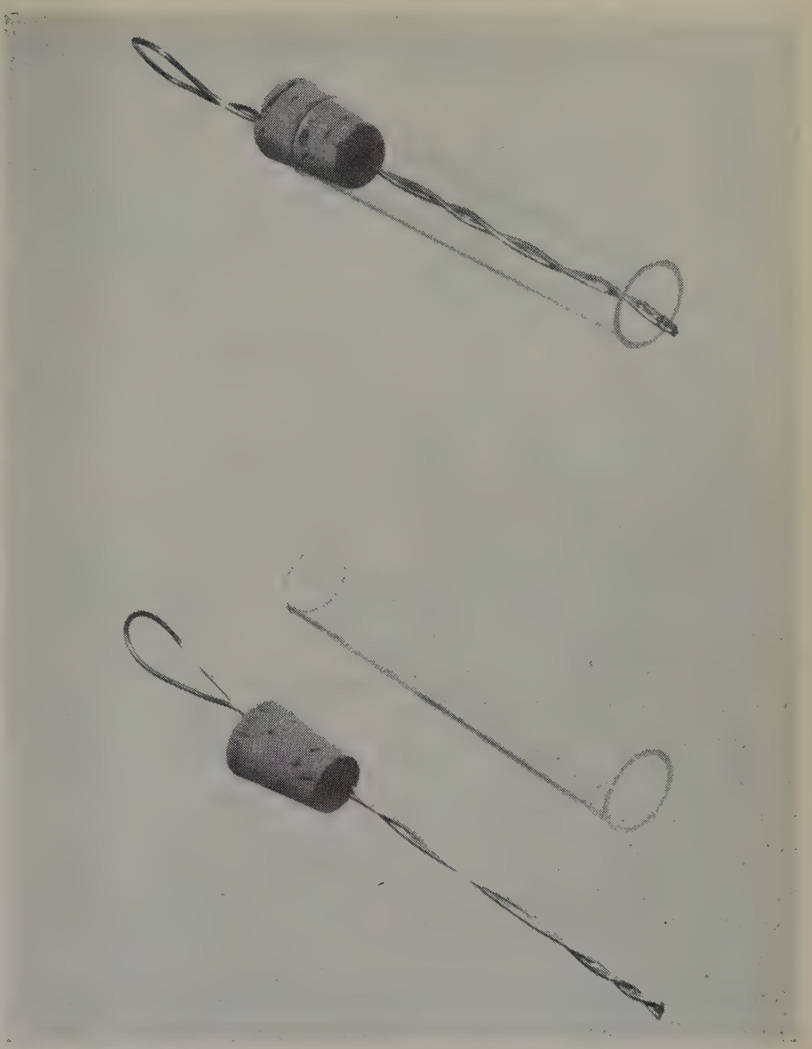


Figure 9, twisted wire test assembly.

The remaining five fluxes can be rated as follows:

1. Flux B (activated rosin-alcohol base)
2. Flux F (water-alcohol-hydrazine base)
3. Flux E (water-hydrazine base)
4. Flux H (glutamic acid hydrochloride base)
5. Flux G (diluted glutamic acid hydrochloride base)

It is interesting to note that there is very little difference between fluxes B and F. In fact, additional testing has shown that certain *highly* activated rosin-base fluxes are actually more corrosive and have less fluxing ability than either the hydrazine or glutamic acid-urea fluxes. As a word of caution it must be kept in mind that many government specifications do *not* permit the use of acid, chloride, and organic fluxes for electronic soldering applications. Certain of these documents specifically state that only a rosin-base flux, rosin-alcohol flux, neutral flux, or non-corrosive flux shall be used. The flux selection must therefore be governed by several factors and no one flux can be designated as the best for all purposes. If any doubt exists as to corrosion or insulation resistance problems, it is always best to select a pure rosin-alcohol or mildly activated rosin-alcohol flux, despite the extra pains which must be taken to secure high quality solder joints. If the rosin-base flux is inadequate and if a more active flux is permitted, a logical choice would be a flux similar to flux F or flux H. Remember to clean soldered boards *immediately* after soldering and to use ultrasonics or several detergent and distilled water rinses. Do not apply excessive flux—spraying is a good way to avoid this—and allow the flux to dry or to be preheated prior to solder dipping.

Letters to the Editor

Scarborough, Ontario, Canada

"I was rather impressed by a statement in your editorial in the July issue to the effect that every month you are tempted to sound off in the editorial on subjects not directly connected with the electrical/electronic insulation field. Well, here is such a subject, which, although perhaps not directly connected, has nevertheless a large and important bearing on this and on all other fields of endeavour. It is the subject of the introduction of the Metric System of Weights and Measures.

"Almost two centuries have gone by since the great French Revolution and the subsequent Napoleonic Wars brought about the almost universal introduction and adoption of this simple and effective system of weights and measures. Unfortunately, this system was not introduced by the English speaking nations, largely perhaps because Great Britain was then at war with France. The metric system was a French invention and therefore viewed with suspicion as possibly being tainted with 'Jacobinism.'

"However, all this is old history now. The suspicions, ill-founded then, can no longer possibly apply. The advantages of the system are so great and so manifestly obvious that it is almost inconceivable that today we still adhere to our prehistoric system with its odd-ball units, its mass of irregular, illogical, and purely arbitrary conversion factors, its general non-convertibility from weight to volume units and its general lack of convenient really small or really large units.

"Let us suppose, for the sake of argument, that suddenly the electrical units of volt, ampere, and ohm were arranged in such a weird manner that, by definition, 1 amp were the current produced by a potential difference of 3 5/16 volts in a conductor of 8 ohms resistance. Let us further suppose that 1 amp were subdivided into 14 'ounce' amps and each 'ounce amp' into 385 'grain' amps. Also that 12 volts equals 1 'foot' volt and that 8 ohms equals 1 'gallon' ohm.

Can you imagine the confusion, frustration, the waste of time and effort which must result from a simple application of Ohm's Law to, say, electronic circuit design, if a system composed of units like the above had to be used. The thought of it alone is enough to produce mental indigestion. To even call such a monstrous collection of units a 'system' would be a gross abuse of the word. To perpetuate it would be a crime.

"Yet this very thing happens every day whenever non-metric weights and measures are used. Isn't it time, high time, that such foolish time and effort wasting nonsense were done away with? We pride ourselves on being the world's leaders in technology, etc., but we persist in using a system of weights and measures which probably even a progressive cannibal would be ashamed to use.

"The main objections one hears when advocating the change-over to metric are: 'It would cost too much to change,' 'It would cause too much trouble, people aren't used to it and may not understand it.'

"None of these objections are valid. No doubt the change-over will cost some money. Probably some machines may have to be altered and a few even replaced. However, the total cost will amount to only a small fraction of what one is lead to believe at first sight. All weigh scales, measuring machines and instruments, liquid meters, thermometers, etc., etc., would only require in most cases new dials and occasionally new gear trains or new smaller fixtures. Such money as might have to be spent would be in the nature of a 'once only' expense. It would be in the nature of a sound investment, since in many cases a thorough overhaul of the machine or instrument in question would result, too, rather than an out-of-pocket expense. To a large extent it would be compensated for by the time and effort saved by the use of the metric system, i.e., by its far greater efficiency and flexibility.

"Regarding the trouble the change-over will cause, this too is vastly exaggerated. The metric system is so simple that in a few months after changing everybody will be accustomed to it and will gladly have forgotten the present system.

"As for not understanding it: It is a lot easier to understand than the present system; in fact there is really nothing to 'understand.' All conversions are 10, or 100, or 1000. The system is self-explanatory and self-indicating, since sub-units or multiple units always carry the same indicating prefix in front of the basic unit, e.g.: milli (0.001), centi (0.01), deci (0.1), deka (10), hecto (100), kilo (1000). Our monetary system is a metric system and no one has ever had any difficulties in 'understanding' it. Finally, Mother Nature herself has generously provided us all with a built-in computer for the metric system, since everybody has 10 fingers or 10 toes, or both.

"So why hesitate any longer? Let's change to metric NOW."

—*E. L. Humburger, Chief Chemist, Schenectady Varnish Canada Ltd.*

Youngstown, Ohio

"We recently sent and you published a news release for Swedlow, Inc. (New Materials and Components, No. Ins. 107, page 71, June). Because of our unfamiliarity with the terms related to military specifications, we said the laminate was 'qualified to MIL-P-18177B.' The Department of the Navy has requested that we revise our literature and publicity to read 'meets MIL-P-18177B.' "

—*David R. Davies, Vice President, Meek and Thomas, Inc.*

Brooklyn, N.Y.

"May we call your attention to the article written by Mr. R. B. Feucht-

(Continued page 42)

SAVE SPACE WITH THIN, EXTRA-STRONG ELECTRICAL TAPES OF MYLAR®

Here's a pressure-sensitive tape that packs great strength into thinner gauges (20,000 psi for 1 mil). Tape of Mylar* polyester film saves space because manufacturers can use thinner gauges with no loss in performance… at lower cost per linear foot.

Want more? "Mylar" also provides—flexibility for snug wraps—high dielectric strength (4,000 v/m†)—dimensional stability at high humidities—moisture and chemical resistance—resistance to temperatures from –60°C to 150°C. And "Mylar" lasts and lasts because there's no plasticizer to dry out with age.

Insulation of "Mylar" gives motors 50 to 100% longer service-free life. Gives capacitors longer-lasting stability, greater reliability. In a wide variety of electrical applications, the advantages of "Mylar" can improve the performance, lower costs. Evaluate "Mylar" for your product. Write for free booklet (SC) detailing properties. Du Pont Co., Film Dept., Wilmington 98, Delaware.

DU PONT
REG. U. S. PAT OFF
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

DU PONT
MYLAR®
POLYESTER FILM

*Registered Du Pont trademark.
†ASTM D-149

Letters, Continued

baum in the July issue of *Insulation* titled 'Integrated Encapsulation Shortens Lead Time.'

"Please note that on page 29 of the credits the implication is that R. B. Feuchtbaum, D. Gurevics and J. Hutter are in the employ of Hughes Aircraft Co. This is completely erroneous since Mr. Hutter and Mr. Gurevics are still in our employ and at the time the paper was presented Mr. Feuchtbaum was also in our employ. This paper was presented under the auspices of Freed Transformer Co. Inc."

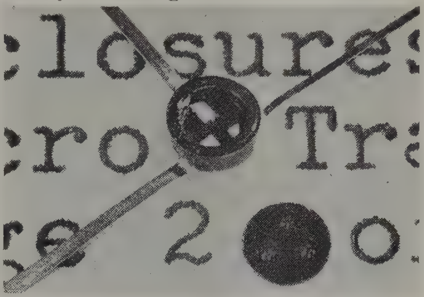
Ed. Note: Two different references were intended. The footnote should have read as follows: Unpublished data, Hughes Aircraft Company; and *The Temperature Coefficient of Inductance in Encapsulated Small Audio Transformers*, by R. B. Feuchtbaum, D. Gurevics, J. Hutter, First National Conference on the Application of Electrial Insulation, Cleveland, Ohio, September 1958.

Glass Microminiature Transistor Enclosure

An all-glass enclosure for microtransistors consists of only two parts — a case and flat cover. Diameter of the enclosure is only 150 mils, and height after sealing is 60 mils. Inside diameter is 100 mils and inside depth is 20 mils. Three coplanar, ribbon leads are an integral part of the case.

A glaze with a low melting point on the top rim of the case reportedly allows a transistor manufacturer to hermetically seal the case and cover with ease. This glass-to-glass seal eliminates the need for welding or soldering the final closure.

The package is suited either for cavity mounting in circuit boards that are 62.5 mils thick or for surface mounting.



The case and cover are made of Corning Code 9361 black glass (Corning Glass Works, Corning, N.Y.). The cover has three bosses that center it on the case for sealing. An electric arc sealing technique that localizes heat and prevents damage to transistor elements is recommended.

Longer Overhead Transmission Cable In Large Sizes

Overhead transmission cables in the larger 6/1 sizes now may be produced up to 50% longer than previously possible. Reynolds Metals Co. recently shipped reels of aluminum cable, steel reinforced (ACSR) to Utah Power and Light Co., Salt Lake City, in AWG sizes 3/0 and 1/0 with lengths of 12,000 and 14,000 feet. Weighing 2770 and 2033 pounds respectively, the reels allowed the utility company to string lines with fewer reel changes.

HAVE YOU TRIED THIS INSULATION?

West Virginia's ***Pressite*** is the heavy-duty pressboard insulation that makes every transformer and capacitor more efficient.

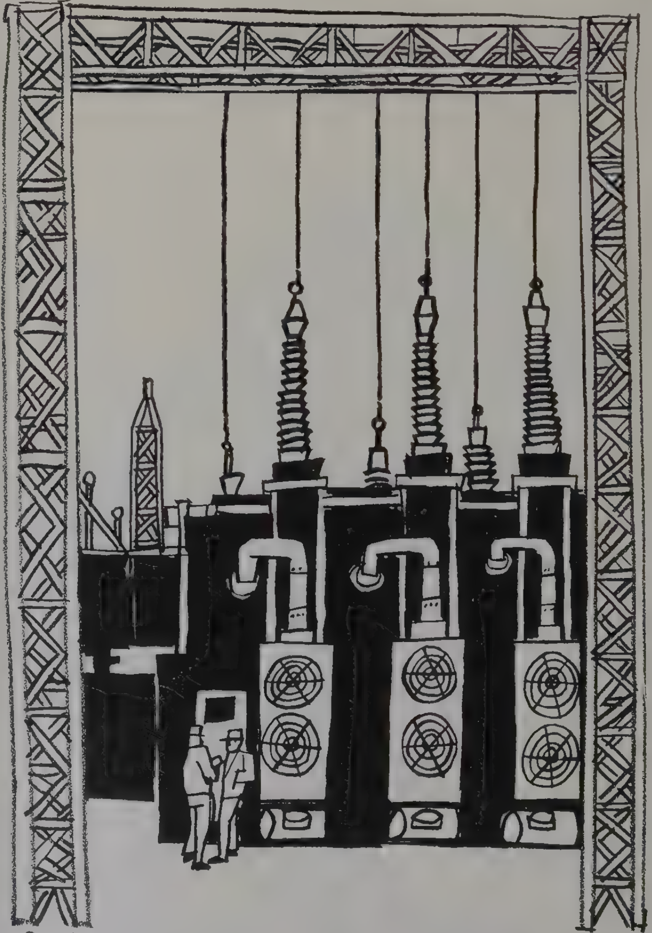
Pressite is made of 100% virgin kraft pulp from our own mill. Our complete product control from forest to mill assures consistent uniformity and absolute purity, with no metallic particles.

For Punchings . . . ***Electrite*** or ***Densite.*** If your project requires a hard board sized to resist moisture, specify Electrite. Even harder is Densite, sized for moisture or unsized for applications in oil.

See How Our Pressboard Can Help You:

For complete technical data on all three grades, plus Underwriters' Laboratories Report #E3987, write Board Products Sales, West Virginia Pulp and Paper Company, Covington, Virginia.

West Virginia
Pulp and Paper



Print Ins. 18 on Reader Service Card

News about R&A SINCE 1913 **Adhesives**

FOR ALL METALS AND ALL PLASTICS

New "room temp" curing epoxy adhesive spreads like cold cream

TECHNICAL DATA ON

Bondmaster® M688

A thixotropic, room temperature curing, 100% reactive, two-component, solvent-free modified epoxy adhesive designed for bonding metals and rigid plastics as well as other rigid materials to themselves and to each other.

APPLICATION

Mixed BONDMASTER M688 is soft and buttery, making it extremely easy to spread smoothly and evenly. Once applied, it maintains its form and DOES NOT FLOW during the curing cycle. Excellent for "poor fit" and similar void-filling applications as well as where dripping or running of adhesive cannot be tolerated.

CURE

Bonded assemblies which have been cured at room temperature can be handled in 4 to 6 hours and develop 85% of their maximum strength in 14 to 24 hours. Alternately, where practical, any of the following heat-cure cycles may be used to achieve full strength more rapidly: 100°F for 2 hours; or 150°F for 30 minutes; or 200°F for 15 minutes; or 250°F for 10 minutes. See Technical Data Sheet for alternate hardeners, pot life, cure cycles, etc.

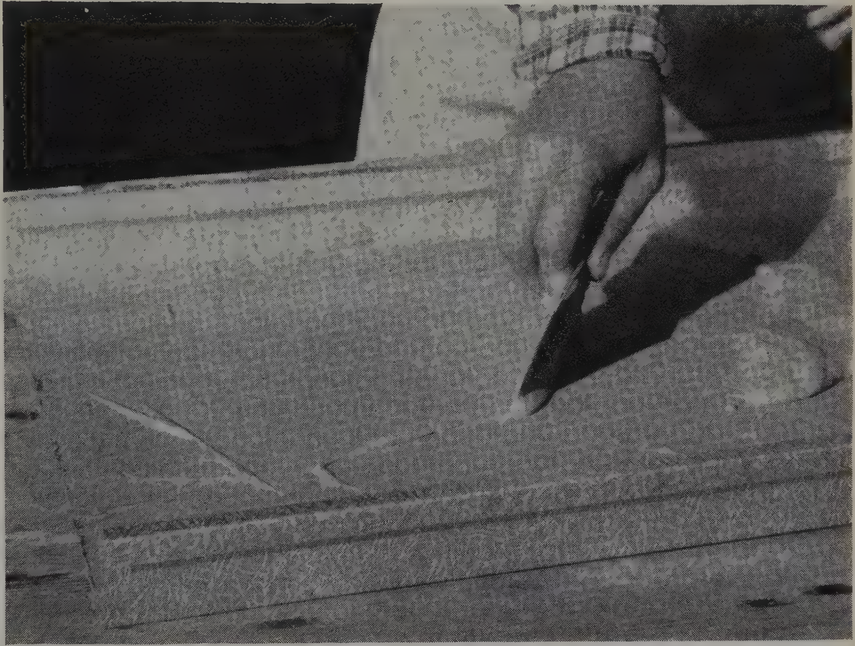
BOND CHARACTERISTICS

Fully cured bonds exhibit minimal shrinkage, are electrical insulators, and provide excellent resistance to weather, galvanic action, and most chemicals, acids, and alkalies.

R&A SINCE 1913

RUBBER & ASBESTOS
CORPORATION

226 BELLEVILLE AVENUE
BLOOMFIELD, NEW JERSEY



Here is why you can save valuable application time as well as material costs with this 100%-reactive, solvent-free epoxy adhesive, BONDMASTER M688:

- Smoothly, easily spreadable with trowel, spatula, knife edge, etc.
- Non-sag (thixotropic) in any position . . . even while curing. Eliminates costly cleanup.
- Cures at room temperature in about 24 hours . . . or in as little as 10 minutes if you can heat to 250°F.
- 100%-reactive . . . no waiting for solvent evaporation . . . mere contact pressure is sufficient.
- Solvent-free . . . no danger of attack on soluble thermoplastics (cells of foamed polystyrene, for example).

Print Ins. 19 on Reader Service Card

ALL METALS—ALMOST ALL PLASTICS

You'll get strong (in excess of 2,000 psi tensile shear on aluminum-to-aluminum, for example) bonds with cast iron, steel, stainless, magnesium, aluminum, copper, brass, bronze . . . *any* metal . . . to themselves or to just about *any* plastic—rigid, foamed, or flexible.

And, of course, to glass, ceramics, wood, and structural laminates based on reinforced melamine, polyester, phenolic, epoxy, etc., resins.

WRITE FOR FURTHER DATA

Write for detailed Technical Data Sheet today. We'll be glad to send a free sample as well if you will describe your bonding problem in detail.

People in the News

R. K. Turner, a recently elected vice president of Union Carbide Corp., died suddenly on July 18. He was 59. *William B. Humes* has been appointed president of Union Carbide Plastics Co., division of Union Carbide Corp., New York City.

W. Humes

R. Braverman

Babcock Electronics Corp., Costa Mesa, Calif., has appointed *Ralph Braverman* to the newly created position of technical assistant to the president.

Dr. Walter K. Volkers has been elected president, director, and chief executive of the Lionel Electronic Laboratories, formerly Anton Electronic Laboratories, Brooklyn, N.Y.

Dr. W. K. Volkers

K. R. Osborn

Kenneth R. Osborn has been appointed to the newly created post of director of industrial development, General Chemical Div., Allied Chemical Corp., New York City.

James V. DeMattei has been made plant manager of the Ossining Div., Hudson Wire Co., Ossining, N.Y. He will continue to direct all purchasing activities for the division.

Ensley C. Smith has joined Electro Nuclear Systems Corp., Minneapolis, as purchasing agent.

Carl E. Gryctko has been promoted to manager of engineering for the Small Air Circuit Breaker Div., I-T-E Circuit Breaker Co., Philadelphia.

C. E. Gryctko

J. W. Cantwell

John W. Cantwell has been named general sales manager and *John J. Baughn* sales manager, Nuclear Systems and Military Products for the Princeton (N.J.) Div., Curtiss-Wright Corp.

James M. Osborne, a project manager assigned to the Radio Corp. of America's Defense Electronic Products organization, has been awarded a 1961-1962 Alfred P. Sloan Fellowship in Executive Development at the Massachusetts Institute of Technology.

Dr. E. O. Ohsol, vice president of Haveg Industries Inc., Wilmington, Del., has also been elected vice president of Haveg Corp. and has assumed the responsibility for all Wilmington operations.

The N. S. Baer Co., Hillside, N.J., has appointed *Roy Benson* as sales engineer.

George H. Aderhold, 61, president and owner of Saxonburg Ceramics, Inc., Saxonburg, Pa., suffered a stroke and died June 9.

At Monrovia, Calif., *Alan B. Dallas* has been appointed director of field engineering for Consolidated Systems Corp., an associate of Consolidated Electrodynamics Corp. *Victor V. Myers, Jr.* has been named assistant director of engineering for the Systems Division there, and *A. Wallace Schnitger* has been named manager of the Space Sciences Department. In Pasadena, Calif., *James C. Crosby* has been promoted to manager of the DataTape engineering department, Data Recorders Div., CEC, and Fred A. Peck has been appointed director of quality control for the Data Recorders Div.

Directors of Oak Manufacturing Co., Crystal Lake, Illinois, have elected *Dean C. Smith* vice president, manufacturing.

D. C. Smith

I. Ginsberg

Irving Ginsberg has been appointed manager of the Buffalo, N.Y., field projects department of the Product Support Organization of Sylvania Electronic Systems, a division of Sylvania Electric Products Inc.

Muscle Shoals Electrochemical Corp., Tuscumbia, Ala., has appointed *C. E. Flanagan* as director of research.

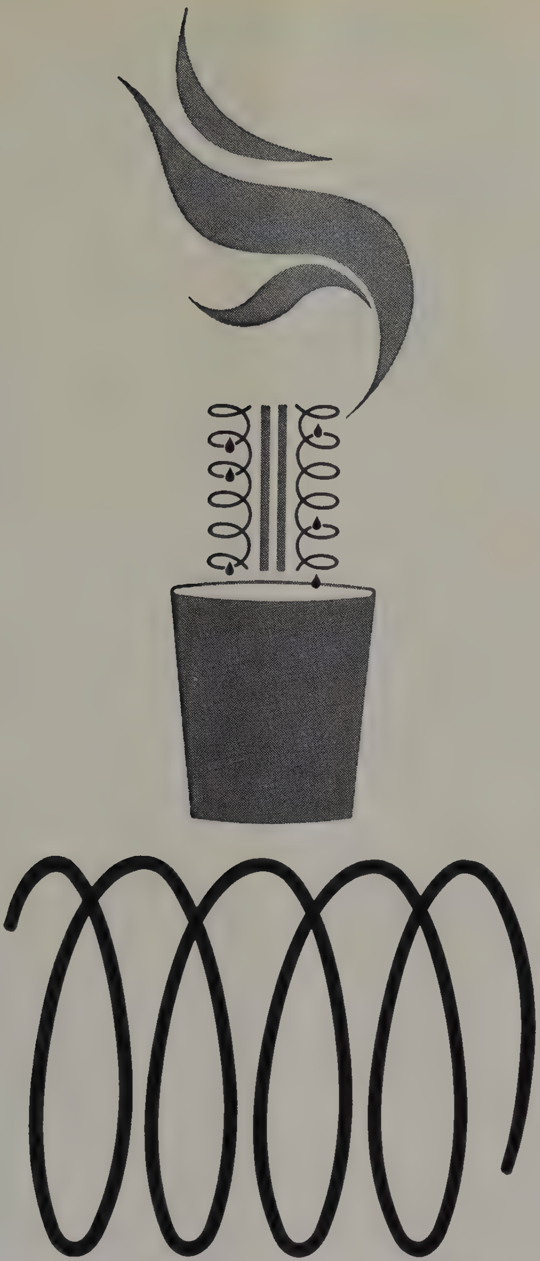
Richard C. Schofield has been appointed California sales representative by Clark-Schwebel Fiber Glass Corp., New York City.

Walter C. Schmieder has been promoted to district manager in the St. Louis office of the Phelps Dodge Copper Products Corp.

At the Okonite Co., Passaic, N.J., wire and cable fabricating subsidiary of Kennecott Copper Corp., *Dr. Robert B. Blodgett* has been appointed director of research, and *Richard C. Waldron* has been named chief engineer.

Changes at Western Insulated Wire Co., Los Angeles, include the following: *George Hunsinger,* appointed chief engineer; *Jack Stumph,* appointed general sales manager; *Hans Hacker,* promoted to factory manager; *Thomas Croston,* promoted to assistant plant superintendent; *Phillip Ramos,* named director of purchasing and production control; *Thomas J. Walsh,* appointed Midwest regional manager, Chicago; and *Frank J. Furnell,* named Pacific Coast regional manager.

The Sterling Varnish Co., Sewickley, Pa., has appointed *David H. Rausch* to handle sales in New England, eastern New York, and northern New Jersey.



IN CLASS F POLYESTER MAGNET WIRE, SPECIFY **ANATHERM-D** FOR IMPROVED HEAT SHOCK RESISTANCE, VARNISHABILITY AND UNEXCELLED WINDABILITY

Anaconda has made important improvements in the heat shock resistance, windability, and solvent resistance of ordinary polyester magnet wire. The result is Anatherm-D, a Class F magnet wire with high thermal stability (155C) ■ High abrasion resistance ■ Excellent flexibility ■ High dielectric strength ■ Superior heat shock resistance ■ Unexcelled windability ■

IDEAL FOR ARMATURES AND FIELD WINDINGS. These improvements over standard polyester wires make Anatherm-D an outstanding choice for motor armatures and field windings, random- and precision-wound coils, specialty windings requiring high temperature resistance, and encapsulated coils.

2-FILM CONSTRUCTION MAKES THE DIFFERENCE. The improved performance of Anatherm-D results from its two-film construction: an overcoat of special terephthalate polyester applied over a base film of Anatherm (the industry's first Class F film-coated magnet wire). The outer film contributes outstanding windability and protection against heat shock and mechanical stress.

CONFORMS TO NEMA AND MIL SPECS. Anatherm-D magnet wire meets all requirements of Spec MIL-W-583B for Class 155 Types L, L2, L3, and L4. It's available in all sizes of round, square and rectangular, with single, heavy, triple and quadruple film additions, all conforming with NEMA specifications. Anatherm-D is available in all standard Anaconda packages: spools, pails, reels and drums. For prices, technical data and application information contact Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York, Department EFL-1-I. 61272

ASK THE MAN FROM

ANACONDA®

FOR ANATHERM-D CLASS F POLYESTER MAGNET WIRE

Print Ins. 20 on Reader Service Card

Association News

Technical Papers on Electronic Components Wanted

Papers on the subjects of electronic components and materials are being solicited for the 1962 Electronic Components Conference. The meeting, to be held May 8-10 in Washington, D.C., is sponsored by the American Institute of Electrical Engineers, Electronic Industries Association, and the Institute of Radio Engineers, with the American Society for Quality Control and the Society for Non-destructive Testing participating. A 500 word summary, together with the author's name and address should be sent to Henry A. Stone, Chairman, Technical Program Committee, Bell Telephone Laboratories, Murray Hill, N.J. Deadline for the summaries is Oct. 9, and authors will be notified of acceptance by Nov. 20.

October Electronics Conference News

The 17th annual National Electronics Conference will be held in the Chicago International Amphitheatre on October 9-11. Over 400 electronic firms will exhibit products, and about 15,000 engineers and scientists are expected to attend. The conference is sponsored by the American Institute of Electrical Engineers, Illinois Institute of Technology, Institute of Radio Engineers, and Illinois and Northwestern Universities.

Approximately 100 technical papers will be presented in lecture rooms located immediately adjacent to the exhibits at the amphitheatre.

Donald C. McDonald, engineering vice president of Sola Electric Co., will be presented with the 1961 Award of Merit for a paper on "Non-Linear Techniques for Improving Servo Performance" which he presented at the 1960 conference.

IEC Elects Dutch President, Reports on Standards Work

G. de Zoeton, president of the Netherlands Electrotechnical Commission, was elected president of the International Electrotechnical Commission at the 1961 meeting in Interlaken, Switzerland, succeeding Dr. Ivan Herlitz of Sweden.

More than 1,000 delegates from 26 nations attended the 12-day meeting devoted to international standards work underway in the electrical field.

The IEC Council approved the memberships of Venezuela and Greece. This raises the total membership to 36 countries. Membership on the nine-member Committee of Action was extended to the United Kingdom, Rumania, and Japan, succeeding India, Netherlands, and Norway.

The IEC reported that 22 standards drafts are now being circulated for final approval before publication in 1961 or 1962.

Also approved by the IEC was the formation of two technical committees: TC 53, digital computers and data processing equipment, with the secretariat awarded to the U.S., and TC 55, winding wires, with the secretariat going to Germany. Other actions included the appointment of Ellsworth F. Seaman, head of technical societies liaison for the Navy Department's Bureau of Ships, as chairman of IEC technical committee 50, environmental testing procedure for electronic components and equipment.

The 1962 general meeting of the IEC has been scheduled for June 24-July 7 in Bucharest, with the 1963 session slated for Venice. Japan was named as the tentative site for the 1965 or 1966 meeting.

Two SPE Retecs in October

Plastics foams and plastics in household appliances are the subjects of regional technical conferences to be held by the Society of Plastics Engineers in October.

Plastics foams will be discussed at the Hotel Lafayette in Buffalo, N.Y. on October 5. The program will feature 17 papers on polypropylene, polyethylene, urethane, epoxy, vinyl, silicone, and polystyrene foams; panel discussions; and opportunities for questions.

Advance registration fee is $10, while registration at the meeting will be $12. Requests for further information and advance registrations should be directed to Andrew J. Hammerl, Retec Registration Chairman, Durez Plastics Division, North Tonawanda, N.Y.

"Plastics in Major Household Appliances" is the subject of another Retec, to be held October 25 in General Electric Company's Monogram Hall, Appliance Park, Louisville, Ky.

Technical program covers material trends, processing trends, and evaluation of plastics products. Papers on plastic foams for insulation, latest processing and fabricating techniques, and flammability will be presented.

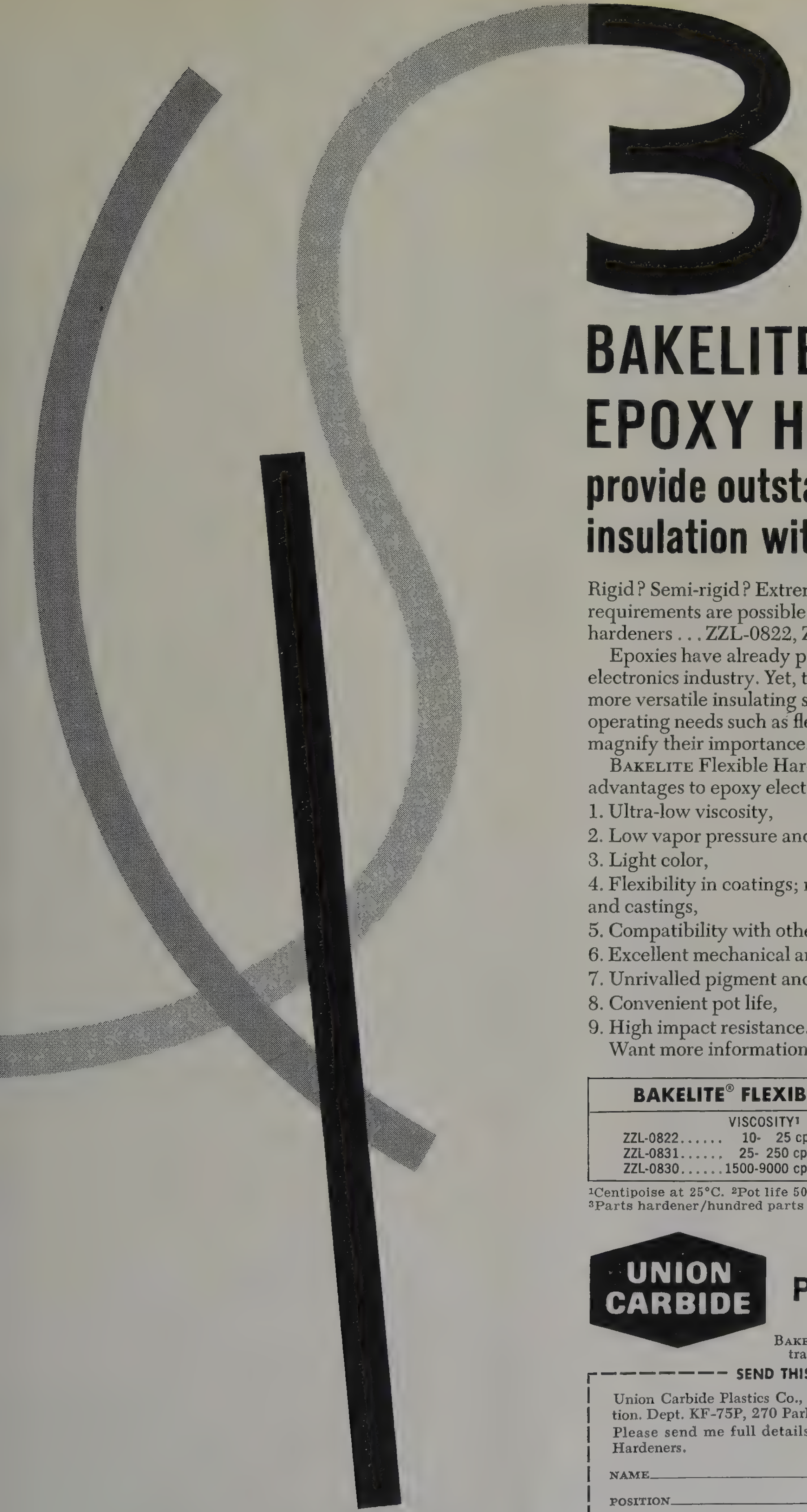
Advance registration fee is $8 for SPE members and $10 for non-members; on-site registration is $10 and $12. Fees include luncheon and a copy of the Retec preprint book. Requests for further information and advance registrations should be directed to H. G. Cooke, Jr., Retec Registration Chairman, c/o Jones Dabney Co., 1481 South 11th St., Louisville, Ky.

Radio Fall Meeting Set for Oct. 30-Nov. 1

The 33rd Annual Radio Fall Meeting has been scheduled for October 30, 31, and November 1 in the Hotel Syracuse, Syracuse, N.Y. The event is co-sponsored by the Electronic Industries Association and the Institute of Radio Engineers.

Aerospace Electrical Society Hosts Annual Display Nov. 15-17

The 1961 Annual Display of the Aerospace Electrical Society (formerly Aircraft Electrical Society), will be held in the Pan Pacific Auditorium, Los Angeles, Nov. 15-17. For information, contact Ed Niles, Executive Secretary, 3540 Wilshire Blvd., Los Angeles, Calif.



BAKELITE® FLEXIBLE EPOXY HARDENERS

provide outstanding electrical insulation with flexibility

Rigid? Semi-rigid? Extremely pliable? Yes, each of these requirements are possible with BAKELITE flexible hardeners . . . ZZL-0822, ZZL-0830 and ZZL-0831.

Epoxies have already proven their worth to the electronics industry. Yet, the development of new, and more versatile insulating systems to meet specific operating needs such as flexibility continues to magnify their importance.

BAKELITE Flexible Hardeners offer important advantages to epoxy electrical insulating compounds:

1. Ultra-low viscosity,
2. Low vapor pressure and high boiling point,
3. Light color,
4. Flexibility in coatings; rigidity in laminates and castings,
5. Compatibility with other hardeners and modifiers,
6. Excellent mechanical and electrical properties,
7. Unrivalled pigment and substrate wetting properties,
8. Convenient pot life,
9. High impact resistance.

Want more information? Send the coupon today.

BAKELITE® FLEXIBLE EPOXY HARDENERS

	VISCOSITY[1]	POT LIFE[2]	HARDENER[3]
ZZL-0822......	10- 25 cps	40 min.	29 phr
ZZL-0831......	25- 250 cps	25 min.	35 phr
ZZL-0830......	1500-9000 cps	70 min.	80 phr

[1]Centipoise at 25°C. [2]Pot life 50 gm at 25°C. with ERL-2774. [3]Parts hardener/hundred parts resin.

UNION CARBIDE PLASTICS

BAKELITE and UNION CARBIDE are registered trade marks of Union Carbide Corporation.

SEND THIS COUPON NOW

Union Carbide Plastics Co., Division of Union Carbide Corporation. Dept. KF-75P, 270 Park Avenue, New York 17, N.Y.

Please send me full details on the BAKELITE Flexible Epoxy Hardeners.

NAME__________

POSITION__________ COMPANY__________

ADDRESS__________

CITY__________ STATE__________

Print Ins. 21 on Reader Service Card

CABLES
à la carte

MENU

Tinned or Silver-plated
Copper Conductors
Solid or Stranded

Insulation of TFE or
100 FEP Teflon;
Silicone Rubber

Jackets of Nylon,
TFE or 100 FEP Teflon
(tape-wrapped or extruded)
Silicone Rubber
or Fiberglass

Multiple Conductors
and Twisted Pairs

Braided Metal Shielding

An engineer can't always design around a stock cable. That's why we make up special cable constructions exactly to fit your needs—from such a variety of components as is suggested by the above "menu." Cables "a la carte" are economical in the long run—because they effect big savings in your wiring and assembly costs. Let us quote you on a special FLEXLEAD cable for your next application. Phone, write or wire!

MARKEL
SINCE 1922
FLEXLEAD®

1 SOURCE for EXCELLENCE
Insulating Tubings and Sleevings
High Temperature Wire and Cable

L. FRANK MARKEL & SONS
NORRISTOWN, PENNSYLVANIA
Print Ins. 22 on Reader Service Card

Industry News

Photo was taken at an Insulation Forum for engineers and purchasing agents held at the University Club, Boston, by the *Huse-Liberty Mica Co.*, Peabody, Mass. Exhibitors included the following suppliers: *Electronic Mechanics Inc., Dow Corning Corp., General Electric Co., Anaconda Wire & Cable Co., Electro-Technical Products, John C. Dolph Co., Permacel, Suflex Corp., Continental-Diamond Fibre Corp., Silicone Insulation Inc., Rayclad Tubes Inc., Chase-Foster Inc., Borden Chemical Co.,* and *Mica Tron Products Inc.*

A $5-million enlargement of facilities for the production of butadiene is nearing completion at the *Copolymer Rubber & Chemical Corp.*, Baton Rouge, La.

A tentative agreement has been reached between *Continental Copper & Steel Industries Inc.* and *Silvray Lighting Inc.* regarding an exchange of Silvray's assets for CC&S common stock.

Cary Chemicals Inc., East Brunswick, N.J., plans to invest $14-million in new production facilities, including construction of a new polymer plant designed to produce 150-million pounds of polyvinyl chloride per year. Cary also recently completed a marketing, financial, and production agreement with *Tenneco Chemical Co.*, a subsidiary of *Tennessee Gas Transmission Co.* Tenneco is building a 100-million pounds per year acetylene plant, and a 200-million pound per year vinyl chloride monomer plant in Houston, Texas.

Rogers Corp., Rogers, Conn., expects to complete the addition to its Manchester, Conn., plant this month. This will double capacity for the manufacture of diallyl phthalate molding compounds.

A French electronics firm called *SAMES* (Société Anonyme de Machines Électrostatiques), Grenoble, France, has established a sales office in New York City to handle its high voltage power supplies, particle accelerators, and electrostatic spray equipment.

Alpha Wire Corp. has moved its Pacific Division to a larger building in Los Angeles.

Carter-Danek Co., Wellesley Hills, Mass., has been appointed to represent *Bishop Manufacturing Corp.*, Cedar Grove, N.J. producer of electrical insulations, in the New England area.

Thermotech Industries Inc., plastics custom molder with plants in Hopkins and St. Louis Park, Minn., is studying sites in Florida for the possible construction of a third plant.

Price Sales Co., East St. Louis, Ill., had been appointed to represent *Centralab*, the *Electronics Division of Globe-Union Inc.*, Milwaukee, in eastern Missouri and southern Illinois.

Spring Street Capital Co., Los Angeles, with a group of private investors, has acquired *Edlab Components Inc.* which holds the stock of *Edcliff Instruments Inc.*, Monrovia, Calif., manufacturer of electrical and electronic equipment, including potentiometers, transformers, transducers, etc.

STEVENS GLASS FABRICS

NOW! THIN-WRAP—HIGH DIELECTRIC STRENGTH

Stevens POLYGLAS* coating fabric provides voltage protection with *FEWER* and *THINNER LAYERS!* Thanks to Glass and Dacron® Polyester, Polyglas can be stretched to conform to intricate contours without opening or tearing, providing the smoothest base possible in woven insulation for cable overwrap. Dielectric properties actually increase after Polyglas coated tape is wound and stretched.

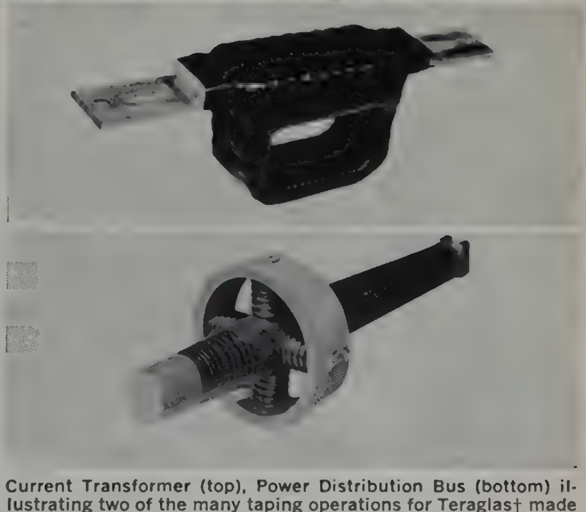
Polyglas is available as a base coating fabric in two-, three-, and four-mil thicknesses in lengths up to 1,500 yards per roll.

Stevens rigid testing and production control assure uniformly high standards and close tolerances.

Write or phone for suppliers of Polyglas coated fabric or tapes.

*64% Glass/36% Dacron® Polyester

Print Ins. 23 on Reader Service Card



Current Transformer (top), Power Distribution Bus (bottom) illustrating two of the many taping operations for Teraglas† made with Stevens new Polyglas fabric. †T.M. Natvar Corp.

J. P. Stevens & Co., Inc.

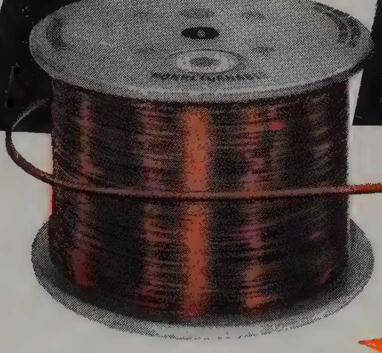
INDUSTRIAL GLASS FABRICS DEPARTMENT
Broadway at 41st Street, New York 36, New York. OXford 5-1000
2838 East Pico Blvd., Los Angeles, California. ANgelus 8-2755

Fine Fabrics Made in America Since 1813

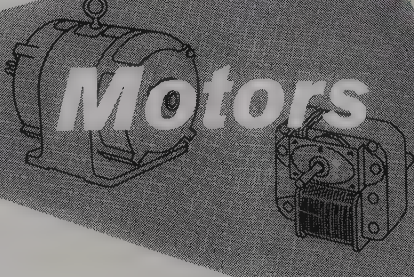
Standardize with this multi-purpose film wire success!

Phelps Dodge

POLY-
Therm



Has replaced as many as six standard wires in these important applications!



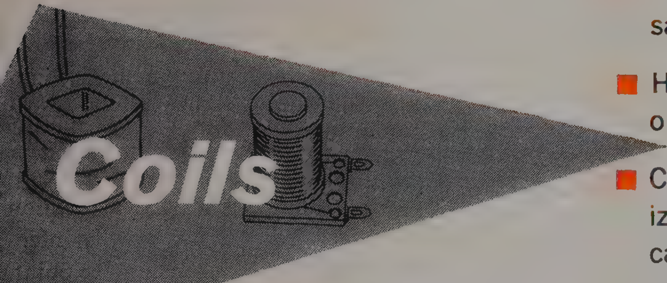
Motors

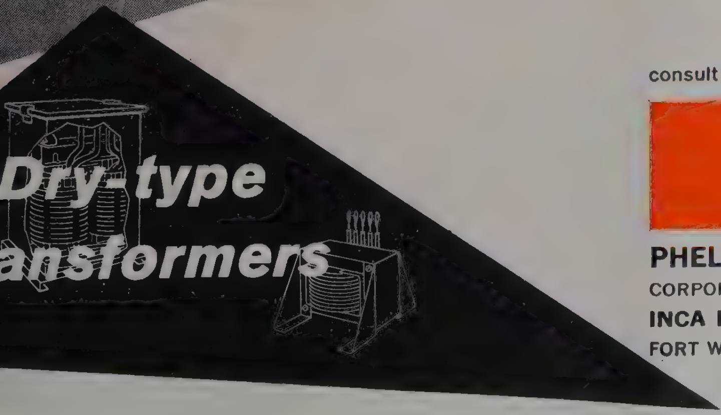
Poly-Thermaleze®—Patents applied for.

Licensees: Rea Magnet Wire Co., Inc., Division of Aluminum Company of America, and Essex Wire Corporation.

aleze®

- Best balance of overall properties without sacrifice of any one property!
- High dielectric for thermal protection at operating temperatures (Class F 155C)!
- Cost reduction benefits through standardizing inventory to one wire for most applications!





Any time your problem is magnet wire,
consult Phelps Dodge for the quickest, surest answer!

P D
MINE TO MARKET

PHELPS DODGE COPPER PRODUCTS
CORPORATION
INCA MANUFACTURING DIVISION
FORT WAYNE, INDIANA

Print Ins. 24 on Reader Service Card

European Insulation Report

Ed. Note: *The author of this monthly European report is a well-known insulation expert associated with a large European electrical manufacturer. Although it is necessary that his identity not be revealed at this time, correspondence may be exchanged with him by writing* European Editor, Insulation, Box 270, Libertyville, Ill.

On the occasion of the opening of the 1961 German Industrial Exhibition in Hannover, some interesting figures about the West German electrical industry were given in the 'Elektrotechnische Zeitschrift' Part. A, Vol. 82, No. 13, June 19, 1961 pp. 397.

In 1960, the rate of growth was 19% compared with the average for German industry of 10.5%. Sales rose by 16% to approximately 20,160-million marks and exports rose 9.7% to 4,243-million marks. At the beginning of 1960 the electrical industry employed 815,000 persons and at the end of the year 850,000.

Pressure-sensitive Adhesive Tapes in The Electrical Industry

By T. R. Alexander in "Electrical Journal," April 14, 1961, pp. 1024-1028.

Besides relatively small differences in adhesives, the various adhesive tapes available differ chiefly in backings. Often, the normal inexpensive adhesive tapes which are also used for electrical insulation suffice, e.g. vinyl insulating tape. However, such self-adhesive tapes normally use adhesives which contain chemicals which cause corrosion of the copper or a reduction in the insulation strength of the tape.

Therefore, for specific electrical stresses, heat curing or thermo-setting resins are substituted. Such tapes also fulfill the most important consideration that the adhesion remain good at higher temperatures. The required tape must be selected after a consideration of the stressing during both manufacture and in service. Many different tapes are at our disposal and several examples are compared in table 1.

Table 1—Properties of Electrical Adhesive Tapes

	Max. Oper. Temp.	Elongation (per-cent)	Thickness (inch)	Insulation Resistance (MΩ)	Electrolytic Corrosion Current (mhos)	Diel. Strength (Volts)
Flat Paper	105°C	5	0.005	20	50,000	2,000
Crepe Paper	105°C	10	0.010	25	40,000	2,000
Cotton Cloth	105°C	10	0.010	100	10,000	3,000
Glass Cloth	130°C	5	0.007	1,000	1,000	3,000
Polyester Film	105°C	100	0.003	2 x 10^6	0.5	6,000
PTFE Film	180°C	200	—	3 x 10^5	3.0	10,000

Corona Discharges and Service Life of Heavy Current Condensers

By W. Held and R. C. Kunze in Elektrotechnische Zeitschrift, Ausgabe A, Vol. 82, No. 11, May 22, 1961, pp. 333-335. Original title: Glimmentladungen und Lebensdauer von Starkstromkondensatoren. Dr. W. Held and R. C. Kunze are with Siemens-Schuckertwerke AG in Berlin-Siemensstadt, West Germany.

Attempts are being made to set in motion an investigation by the IEC in order to work out and standardize type-tests for the determination of the ionization of condensers since at the moment there exist many measuring techniques.

After full consideration, the authors come to the conclusion that laboratory measurements for development work and workshop measurements for production control are indispensable but cannot be considered as type-tests since the various assumptions made are not usually given. There are no existing methods which are suitable for type-testing and the authors have the view, which is without doubt correct, that the dimensioning which is decided by the corona onset must be left to the manufacturers. All factors can be considered only on this basis.

The chief problem is the choice of the right insulation thickness so that it is the best compromise between higher breakdown voltage and smaller ionization. These two demands are in opposition since the corona onset field strength falls as the insulation thickness increases (see figure 1 page 54).

Short-time discharges on overload cannot be avoided. By means of aging tests therefore, the amount of corona permitted must be determined so that no preliminary aging of the insulation takes place in service. The results of such tests are shown in figure 2 page 54).

It can also be seen that the correlation of the measurements is difficult and the insulation thickness must also be given due consideration since the larger the output of the condenser, the smaller is the indication on an instrument of an equally intensive and equally large defective point.

The Mechanism of Ionization in the Air Space Between Solid Dielectric Materials

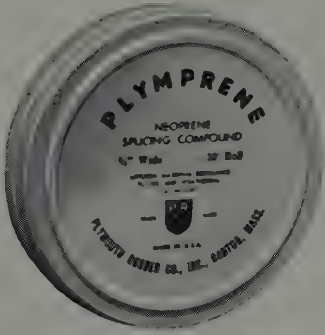
By B. Heller in Acta Technica No. 3, 1961 pp. 203-204. Original title: Die Ionisierungsvorgänge in der geschichteten Anordnung festes Dielektrikum-Luft. Dr. B. Heller is a member of the Czechoslovakian Academy of Science.

This work is a very interesting attempt to formulate mathematically

FOUND IN ALL THE BEST SPLICES

PLYMPRENE NEOPRENE SPLICING COMPOUND

A highly weather-resistant splicing tape for maximum protection against oils, alkalies and weather extremes.



PLYMOZONE SPLICING COMPOUND

For maximum high voltage resistance to ozone and moisture, Plymozone ozone-resisting splicing compound exceeds ASTM D-1373. Plymozone withstands four times the ozone concentration used as ASTM standard.

PLYMOUTH SPECIAL (ASTM) FRICTION TAPE

Guaranteed 82½ feet per roll. Exceeds all requirements of ASTM D-69 and U.S. Government Specification HH-T-101A.

PLYMOUTH SPECIAL (ASTM) SPLICING COMPOUND

A high voltage rubber tape guaranteed to exceed ASTM specification D-119 and U.S. Government specification HH-T-111C.

SLIPKNOT CW ALL-TEMPERATURE PLASTIC TAPE

.0085" thick
No matter how cold the working conditions, Slipknot CW Vinyl Electrical Tape remains flexible and strips perfectly from the roll. A true all-temperature vinyl tape with an application temperature range of −14°F. to +176°F.

SLIPKNOT No. 7 PLASTIC TAPE

.007" thick
The standard of the industry, in the FLIP-N-CUT® Instant Tape Dispenser. Resists water, acids, alkalies, oils, corrosion. Molds totally around any shape. Minimum dielectric strength of 10,000 volts.

Also SLIPKNOT No. 10 — .010" thick

TAPES BY PLYMOUTH RUBBER COMPANY, INC.
SOLD ONLY THRU RECOGNIZED DISTRIBUTORS

SEND FOR SAMPLES ON YOUR LETTERHEAD
PLYMOUTH RUBBER COMPANY, INC.
QUALITY SINCE 1896 CANTON, MASSACHUSETTS

Print Ins. 25 on Reader Service Card

the behaviour of the air space between two solid insulation materials. The method of calculation is guided and controlled by the published test results of T. W. Dakin and M. Burnier.

In the first part, the behaviour of the air space under corona conditions is examined, in particular with regard to the energy variations. The equivalent circuit as in figure 3 is used and a fictional voltage is assumed in order to simplify the calculation.

In the second part, the effect of the surface resistance at the boundary between the solid dielectric and air is investigated under corona conditions. It appears from this mathematical treatment that the usual equivalent circuit (figure 4), as given in most literature on the subject, is incorrect. A new equivalent circuit which permits a very good numerical treatment of the problem is therefore proposed (see figure 5, page 56).

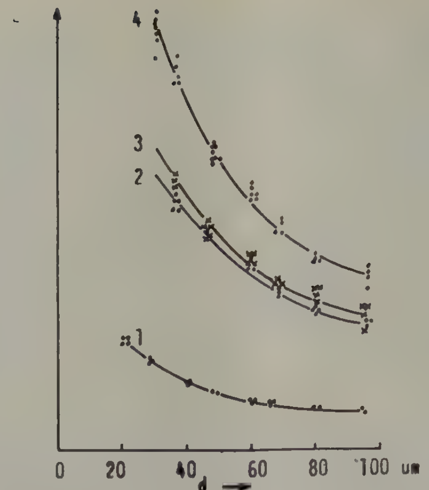


Figure 1, corona onset field strength E of the condenser insulation as a function of the total thickness d in mm of the dielectric. Curve 1—no impregnation; 2—impregnated with Clophen 50; 3—impregnated with mineral oil; 4—impregnated with Clophen 50.

A formula is drawn up for the calculation of the values of the capacity of the corona-cell as a function of the applied voltage. This formula is checked from the results of the measurements made by Dakin.

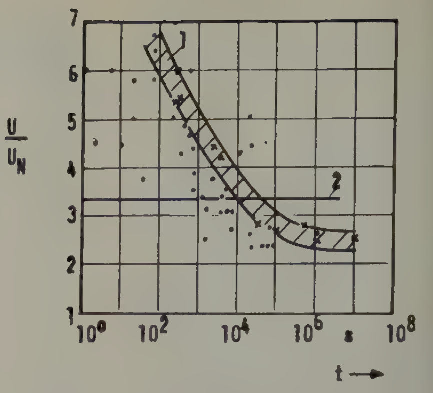


Figure 2, breakdown voltage for insulation with Clophen impregnation as a function of the overload time t. Range 1—breakdown range for impregnated insulation. Curve 2—corona onset voltage for dielectric thickness d. Measuring points with thickness d, and Clophen A 30. Measuring points with thickness d_2.

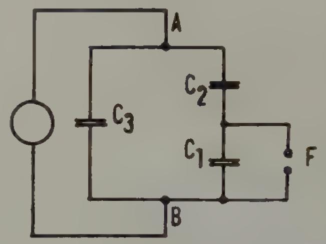


Figure 3, capacitance scheme for a gaseous void in a solid dielectric. C_1, C_2, C_3, F corresponding to Figure 5.

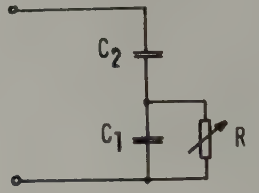


Figure 4, the equivalent circuit usually given in literature for a gas void in a solid dielectric with a resistivity R on the solid insulation surface.

Study of Electric Breakdown of Liquid Dielectrics Using Schlieren Optical Techniques

By B. Farazmand in the British Journal of Applied Physics, Vol. 12, No. 5, May 1961, pp. 251-254. B. Farazmand was with the Dept. of Electrical Engineering, Birmingham University, England.

The author investigates the electrical breakdown of liquid dielectrics by a consideration of the physical properties. The tests were carried out on n-hexane. A very refined arrangement using the Toepler-Schlieren

Sames

ELECTROSTATIC GENERATORS

Utilized Worldwide for Applications in:
Nuclear Physics, Insulation Testing, Electron Microscopy, Mineral Separation, Electrostatic Precipitation

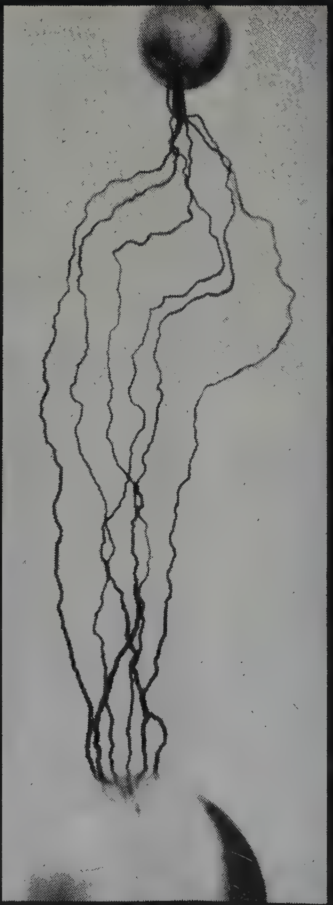
Provide High-Voltage Power Supplies in a Wide Range of Models...Featuring:

- Essentially pure DC output
- Voltages to 600 KV, infinitely variable
- Current to 14 ma
- Medium or High Stability, to 0.1% hr. drift
- Easily adjustable, closely regulated output voltages to .001%
- Simplified maintenance, long life
- Extreme safety: Low output capacitance, Minimal short-circuit & overload currents, Remote adjustment & shut down

Write now for new Catalog 100 covering the complete line of Sames Electrostatic Generators.

Sames

30 Broad St., Rm. 3703, New York 4, N.Y.



Print Ins. 26 on Reader Service Card

WEST VIRGINIA ARMATURE CO. USES NATVAR ABOGLAS® in Rewinding Heavy Duty Mine Motors

Winders starting a coil in a Westinghouse 500 KW, 600 volt, 1200 RPM Rotary Converter Armature.

Because of its flexibility, Aboglas is easy to handle, and its mechanical and electrical properties are excellent. Aboglas is being used here, not only to separate the end turns, but also as a separator between the top and bottom coils in the slot portion of the armature.

Aboglas easily adapts itself to the contour of a large armature. This ability to conform to irregular surfaces, plus high mechanical and electrical strength makes it popular for important rewind jobs.

West Virginia Armature Co., with main plant in Bluefield, and five branch plants in other important coal mining areas, has built an excellent reputation for Service since its founding in 1909.

This Company has been using Aboglas for some time as shown in the accompanying photos, and also as a separator between the shunt and series sections of compound field coils.

Aboglas, a composite consisting of a layer of varnish saturated asbestos paper sandwiched between two layers of varnished open-weave Fiberglas*, is only one of the Natvar insulations developed to do a specific job, and do it well. If you are using flexible electrical insulations, it will pay you to investigate the Natvar line. You can depend on their uniformly high quality, and you can get them either from your own wholesaler or direct from us.

NATVAR CORPORATION

FORMERLY THE NATIONAL VARNISHED PRODUCTS CORPORATION

Telephone	TWX	Cable Address
FULTON 8-8800	RAHWAY, N.J., RAH 1134	NATVAR: RAHWAY, N.J.

239 RANDOLPH AVENUE • WOODBRIDGE, NEW JERSEY

Print Ins. 27 on Reader Service Card

Natvar

Natvar Products

- Varnished cambric—sheet and tape
- Varnished canvas and duck—sheet and tape
- Varnished silk and special rayon—sheet and tape
- Varnished papers—rope and kraft—sheet and tape
- Varnished, silicone varnished and silicone rubber coated Fiberglas*—sheet and tape
- Slot cell combinations, Aboglas®
- Teraglas®
- Isoglas® sheet and tape
- Isolastane® sheet, tape, tubing and sleeving
- Vinyl coated and silicone rubber coated Fiberglas tubing and sleeving
- Extruded vinyl tubing and tape
- Styroflex® flexible polystyrene tape
- Extruded identification markers

*TM (Reg. U.S. Pat. Off.) OCF Corp.

We will be very happy to supply information on any of our products on request.

RIEGEL
ELECTRONIC
BOARD

For standard or modified systems

Riegel Electronic Board is used with confidence everywhere . . . for transformers, rotating machinery, cylinders, bushings and coil forms. Whether your manufacturing requires standard or modified electronic board, you can get it from Riegel. Riegel Electronic Board is cylinder kraft made with optimum balance of electrical, mechanical and chemical properties. It is free from lumps, grit and metal impurities and can be tested 100% for conducting paths.

Riegel Electronic Board can be supplied plain and coated with shellac, wax or special resins to your specific requirements . . . in sheets or rolls . . . thicknesses from 0.003 to 0.031″. Write for electrical data folder: Riegel Paper Corporation, Box 250, New York 16.

Riegel

SPECIALIST IN
ELECTRICAL PAPERS

Coated Electronic Board   Electronic Board
Waxed Electronic Board   Cable Insulating
Dacron Paper   Conductive Paper
Resin Impregnated Paper
. . . and many others

Print Ins. 28 on Reader Service Card

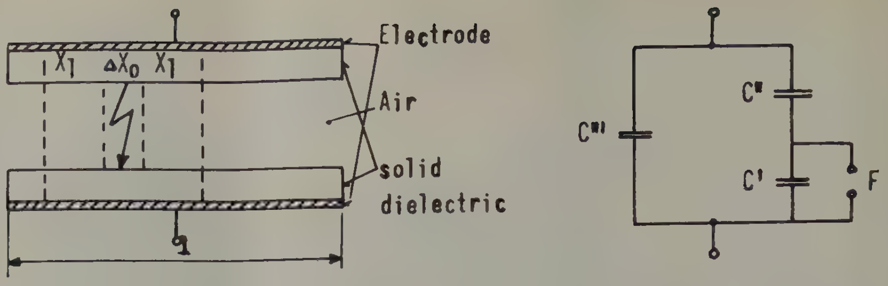


Figure 5, no ionization in the air space gives: C_1, C_2 are the capacities of the air space and solid dielectric, respectively. C_3—the total capacity. F—spark gap is the elementary area corresponding to Bernstein and has a value of approx. 0.15 cm.

$$C'=C_1\,\frac{2X_1+\Delta Xo}{l} \qquad C'''=C_3\,\frac{l-(2X_1+\Delta Xo)}{l}$$

$$C''=C_2\,\frac{2X_1+\Delta Xo}{l}$$

system is used to photograph the prebreakdown and the post-breakdown conditions. A region of very low refractive index was observed at the cathode. The author has concluded that this may be a result of the disturbances traveling towards the grounded electrode.

An Assessment of Inhibited and uninhibited Insulation Oils Used in High Voltage Power Transformers and Instrument Transformers

By E. Rey and L. Erhart in the "Bulletin des Schweizerischen Elektrotechnischen Vereins," Vol. 51, Number 11, June 3, 1961, pp. 401-414. Original title: "Die Beurteilung von inhibierten und nichtinhibierten Isolierölen für Hochspannungs-Transformatoren und Messwandler." Prof. Dr. E. Rey is with the chemical department of the Aargauischer Kantonschule, Switzerland, and L. Erhart is with Sprecher und Schuh AG, Aarau, Switzerland.

The authors state first that considering the same transformer, there is no direct connection between tan δ results as a function of temperature for the aged oil and the condition of the solid insulation.

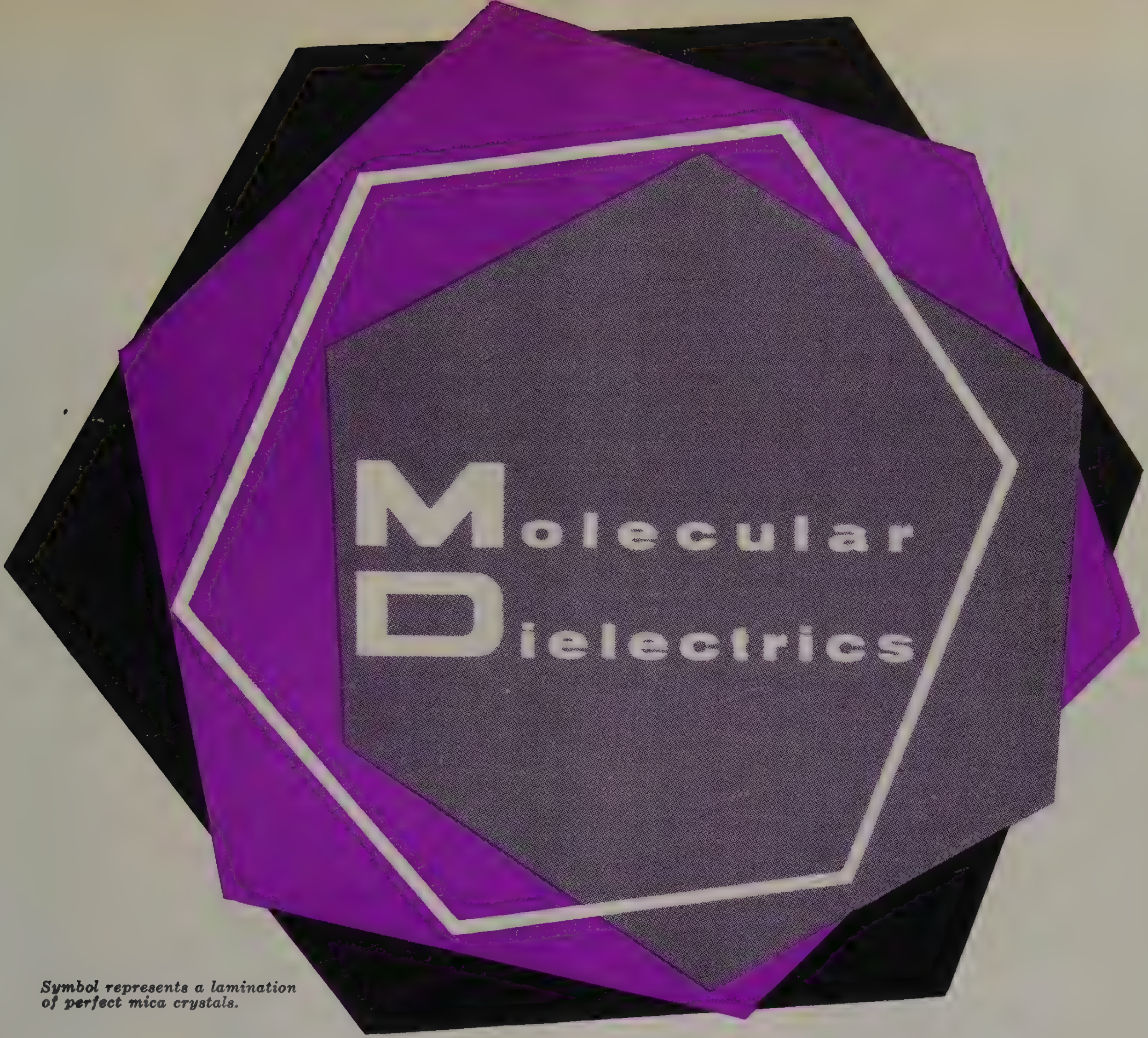
By periodic regeneration of the oil, it is possible to keep the insulation material in good condition for a long time.

Naturally one endeavours to preserve the initial properties of the insulation when it is in service. Various constructive measures stand in the foreground. In Europe, the majority of transformers are eqiupped with a conservator and silica-gel drying. In America, a hermetically sealed nitrogen atmosphere has been used for a long time. For the majority of the high voltage instrument transformers produced today, an air tight container is used.

Besides the general design and construction, the drying and nature and quality of the solid insulation are of the utmost importance as are the quality of the oil, the pretreatment, and the impregnation.

Using chemical and physical methods, the authors investigated a large number of oils to find a means of giving information about the composition of an oil.

Much can be interpreted from the infrared absorption spectrum but in certain cases, the interpretation of a known absorption band is very difficult. Very satisfactory results can also be obtained with Stahl's thin film chromatography technique (chromatostrips and chromatoplates from Demole). These economic, highly sensitive, and universal techniques allow the inhibitors, oxidation products, and impurities in a cubic millimeter of insulating oil to be determined microanalytically from a concentration of a single Gamma, i.e. 10^{-6} gram. An example is given in figure 6 and from this figure it is clearly evident how the inhibitor behaves in the oil during the artificial



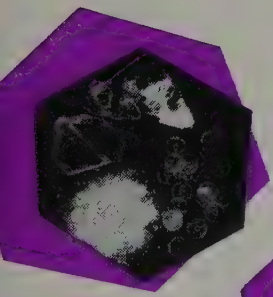
Symbol represents a lamination of perfect mica crystals.

THERE IS A NEW SYMBOL IN

insulation

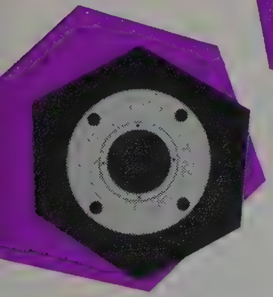
. . . a symbol which stands for exploration of the molecular sciences for insulation • individual approach to your design problems • 25 years' experience in ceramoplastic technology and production know-how • the world's largest facilities for research and manufacture of glass-bonded mica products • a complete range of highly stable mica-based materials.

The consolidation of Electronic Mechanics, Inc., Mykroy Manufacturing Co. Inc., and Mykroy, Inc., to form Molecular Dielectrics, brings the engineer a new source of experienced design counsel, and prototype and volume production. Under the same management, MD's facilities and talents are being applied to the full exploitation of the molecular sciences in the development of new materials for insulation.



THERMICA®
MAN-MADE MICA

MYKROY®
GLASS-BONDED MICA



MICACERAM
MICA-BONDED MICA

Consult MD for creative solutions to your special insulator problems. Send your prints for estimates.

Molecular Dielectrics, Inc.
ELECTRONIC MECHANICS, INC. MYKROY, INC. MYKROY MFG.CO., INC.
101 CLIFTON BOULEVARD, CLIFTON, NEW JERSEY

Print Ins. 29 on Reader Service Card

CHEMPRO TEFLON*
"INSULATION" GRADE
STOCK
ONLY HIGHEST QUALITY
ELECTRICAL GRADE POLYMER USED

You get better, longer lasting parts from Chempro Teflon "Insulation" Grade Stock. It is made from electrical grade TF-5 polymer. This pure, high quality material assures you a denser, more uniform Teflon for greater service life.

Chempro "Insulation" Grade Teflon is being used as connectors, inserts, spacers, wrappings in connection with standard and special high voltage, high frequency and high temperature electronic, electrical and military equipment.

Prices and deliveries quoted promptly. Write for Bulletin CP-554.

TAPE

Pressure-Sensitive Tape — Used as a Class H insulating tape. Available 0.0035", 0.006" and 0.013" thick, in standard widths from ½" to 2" in 18-yard and 36-yard rolls. A special 12" wide tape is now available by the linear yard.

Standard and Cementable Tapes — .002" to .005" thick in widths from ¼" to 24"; .006" to .096" thick in widths from ½" to 24".

TEFLON SHEETS

Standard sizes are.
24"x24" and 48"x48"

THICKNESS (inches)	WEIGHT (lbs./sq. ft.)	THICKNESS (inches)	WEIGHT (lbs./sq. ft.)
1/16	0.75	½	6.00
⅛	1.5	¾	9.00
3/16	2.25	1	12.00
¼	3.00		

RODS

EXTRUDED — ¼" to 2" diameter in increments of 1/16", in lengths up to 12'.
MOLDED — 1⅛" to 2" diameter lengths up to 12", in increments of ⅛"; 2" O.D. and over in increments of ¼" in lengths from 6" to 12".

MOLDED CYLINDERS

2" O.D. and up with minimum wall thickness of ½" in increments of ¼". Maximum length is 12".

*duPont trademark

CHEMICAL & POWER
PRODUCTS, Inc.

11 Broadway, New York 4, N. Y.

Print Ins. 30 on Reader Service Card

aging. It also shows clearly how the extraction of aging products by filtration through silica-gel, Floridin or Fullers earth, aluminum oxide or Betonit, can be controlled by this new method. The inhibitor was also withdrawn.

For the aging, a slight modification of the CEI method is used (temperature 100°C, oil quantity 25 grams, copper wire-length 122 cm and diameter 1 mm, 1 liter of oxygen per how, aging time 169 hours).

From the results obtained from tests of different oils, it appears that a full interpretation of the aging results is possible only in conjunction with measurements of the loss factor as a function of temperature.

However the tan δ results give no information about the neutralization value, sludge formation, or other causes of a possible serious deterioration in the results during the test.

The authors thoroughly cover the solubility of gases in the different oils, and results from tests using air, nitrogen, and hydrogen are published. The insulating oils which can absorb gases have a higher content of aromatics and therefore are prone to faster aging. The authors hold the view, therefore, that the best solution is not to use such oil and to keep the corona onset voltage in the transformer higher than 2 or 3 times the rated voltage. This then guarantees that when no corona occurs, no soluble gases can be produced which must be absorbed.

The authors propose that insulating oils should be used in the future only if it is made clear that not all oils can be safely inhibited against aging. The greatest attention must be paid to the choice of an inhibitor so that the correct one is chosen.

This long article is illustrated with examples and experiences and the authors have attempted to explain all the occurrences from the point of view of the chemical composition of the oil. The article is also very readable.

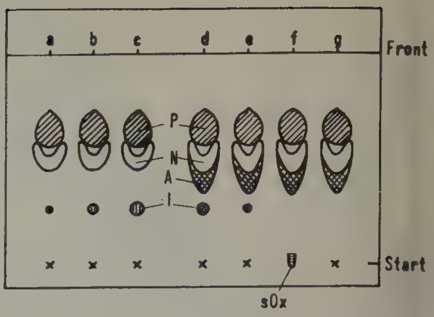


Figure 6, thin film chromatography for differently treated oils. a) Oil consisting of almost equal parts paraffins P and naphthas N and inhibited I with 0.01% DTBP. b) The same oil with 0.1% DTBP. c) The same oil with 1% DTBP. d) Oil consisting of paraffins P, naphthas N, aromatics A and inhibitor I. e) Oil d) aged for 7 days using IEC method. f) Oil d) aged for 20 days using IEC method. g) Oil d) after filtration with aluminum oxide acidic oxidation products.

Testing of High Tension Insulators

By H. Kläy in Electrical Service (International Review for Electricity Utilization) Vol. 36, No. 1, January 1961 pp. 1-5. Original title: Prüfungen von Hochspannungs-Isolatoren. Dr. H. Kläy is with Porzellanfabrik Langenthal A.G., Langenthal, Switzerland.

The article is concerned with test criteria for porcelain multi-section post and for strings of cap-and-pin insulators for service voltages up to 380 kv. The usual guard rings are to improve corona onset voltage and serve as lightning protection, but they scarcely improve the voltage distribution.

With solid-core and suspended cap-and-pin insulators working loads of 25 tons have been attained. For supporting insulators the shear stresses vary between 400-800 kg.

The possibility is shown that the mechanical strength can be greatly improved by suitable construction. To evaluate the compressive and tensile forces in the material, the photoelastic method is used.

Great importance is attached to the ultrasonic test for the discovery of cracks and porosity in insulators.

In order to control stresses appearing in porcelain in use, the impact of short, sharp blows is measured using strain gauges.

Dolph's®
t 175°C
sion
operating at 175°C
able of operating at 160°C
ance
e with excellent covering ability
xibility
dhesion
up
resistance, capable of operating at 160°C
ce
remely high bonding strength
ery quick cure
ood thermal stability
1. Extremely good solvent resistance
2. Good thermal stability
3. Very quick cure
4. Good bonding strength

Dolph's® makes it easy to select the right class F varnish from industry's most complete line

Now, Dolph makes it easy to select the Class F HI-THERM® insulating varnish that's formulated right and priced right for all of your insulating requirements. No need to pay a premium price for performance you don't need on one job . . . or settle for below-spec performance on another. Use this guide to select the right varnish at the right price from Dolph's complete, job-proven, Class F line. For complete data on Class F varnishes, write for folder IN-1.

JOHN C. DOLPH COMPANY • Monmouth Junction, New Jersey

Licensees: England: The Walpamur Co. Ltd., Darwen, Lancashire • **Italy:** Societa Albesiano, Moncalieri (Torino) • **Canada:** Crown Diamond Paint Co. Ltd., Montreal • **Chile:** Sociedad Quimica Nacional "Soquina", Santiago • **Mexico:** Pinturas Para Mexico S. A., Mexico 16, D. F.

Print Ins. 31 on Reader Service Card

MIDWEST MOLDING AND MANUFACTURING COMPANY PRODUCTS

CAN DELIVER

Automatic Molded

Plastics Units

WITH SUCH ADVANTAGES AS:

Low Mold Cost
Short or Long Runs
Low Piece Cost

SEND YOUR PRINTS FOR QUOTATION

Midwest Molding
AND MANUFACTURING COMPANY

PLASTICS
CUSTOM-ENGINEERED

789 ROTARY DRIVE
GURNEE, ILLINOIS

Print Ins. 32 on Reader Service Card

New Publications

Third Alloyd Electron Beam Symposium Proceedings. Edited by Robert Bakish. Contains 22 papers covering such areas as the physics of electron beams, electron beam welding, less known electron beam applications, and electron beams in microminiaturization. $15. Alloyd Electronics Corp., 37 Cambridge Parkway, Cambridge 42, Mass.

Design Manual for Transistor Circuits, by John M. Carroll. Contains a review of basic transistor and semiconductor theory, discusses use and applications of transistors, and stresses advances made in semiconductors during the last three years. 376 pages, 8¾″ x 11″, $9.50. McGraw-Hill Book Co., 330 West 42nd St., New York 36.

ASTM List of Publications. Describes the symposiums, manuals, special publications, indexes, compilation of standards, charts, reference photographs, and reports published by the American Society for Testing Materials through the years. 40 of the more than 300 items are new. Free. 62 pages. ASTM, 1916 Race St., Philadelphia 3, Pa.

Advances in Electron Tube Techniques, edited by David Slater. Proceedings (45 papers) of the Fifth National Conference on Tube Techniques. Illustrated, 11″ x 9″, 242 pages, $15. Pergamon Press Inc., 122 East 55th St., New York 22.

OTS Publications

The following publications may be obtained from the Office of Technical Services, Business and Defense Services Administration, U. S. Dept. of Commerce, Washington 25, D.C.

PB 171 036, *Technical Resources Directory in Plastics* (January 1961). Defense Department-sponsored Plastics Technical Evaluation Center survey of all Army, Navy, and Air Force research and development work in plastics includes a detailed breakdown of the activities of each installation. It also contains listings of end items of interest to military installations; names of engineers engaged in developing or manufacturing (or both) the plastics items listed; the names, addresses, and telephone numbers of the installations; and telephone extensions of individuals. 147 pages, $2.75.

PB 171 522, *Research on High Temperature Polymers,* by J. B. Rust and others. Describes an investigation which resulted in the synthesis and characterization of two general categories of metalloxane polymers. 124 pages, $2.75.

PB 171 401, *Molecular Weight Determination in the Characterization of Polymers,* by R. M. Lange. 28 pages, 75 cents.

NEMA Standards

The following new and revised standards publications have just been issued. Copies may be obtained from the National Electrical Manufacturers Association, 155 East 44th St., New York 17.

AS 1-1961, *Definitions for Industrial Automatic Systems.* 35 cents.

DC 6-1961, *Automatic Temperature Controls* (nameplate information, ampere ratings, voltage rating, and load characteristics). 25 cents.

HE 2-1961, *Electric Comfort Heating Equipment.* 35 cents.

HS 1-1961, *Household Electric Dishwashers.* 25 cents.

HU 1-1961, *Industrial Heating Units and Devices.* 35 cents.

HV 10-1961, *American Standard Test Methods for Electrical Power Insulators* (ASA C29.1-1961). $1.50.

MW 2-1961, *Single and Heavy Polyurethane-coated Round Copper Magnet Wire.* 35 cents.

TR 2-1961, *EEI-NEMA Standards for Distribution Transformers, Overhead Type*—Seventh Report (EEI 60-54). $1.25.

WC 21-1961, *Nonreturnable Reels for Wire and Cables.* 30 cents.

100-1960, *EEI-NEMA Standards for Mounting Brackets for Distribution Cutouts and Distribution-class Lightning Arrestors* (EEI TDJ-19). 30 cents.

Fluidized Bed Coating . . . A Progress Report

After six years of intensive research and development, the WHIRLCLAD* Coating System, using a fluidized bed of dry powder, has become a commercially feasible and economical process now fully adapted to volume production. The Polymer Corporation, through its WHIRLCLAD Systems Engineering facilities, has helped more than 100 manufacturers achieve volume production quickly and efficiently.

Q. What types of companies are using the WHIRLCLAD Coating System?

A. Both large and small companies in many different fields of industry. Typical companies are: Allis-Chalmers, Barber-Colman, General Electric, General Motors, Globe Industries, International Harvester, Jones & Laughlin, Kuhlman Electric, Leland Airborne Products, McGraw-Edison, RT&E Corp., Rockwell Manufacturing, Rotron, Uptegraff, Wagner Electric, Westinghouse and many others.

Q. Why is the WHIRLCLAD Coating System used?

A. It offers important product advantages and fabricating economies compared with other coating methods. One quick dip in a fluidized bed of dry powder forms a uniform coating free of sags or bridging. Experience has proven that a correctly-engineered WHIRLCLAD system is highly reliable; there are virtually no interruptions in production of the type that plague liquid process finishing systems.

Q. How does Polymer help manufacturers start using the WHIRLCLAD system?

A. Polymer's Systems Engineering Group is available to manufacturers for the design of efficient and economical coating systems and for establishing detailed specification of the components and equipment required. It also offers the facilities and experience of the WHIRLCLAD Development Laboratory to evaluate materials and develop techniques for economical operation. This service can draw upon a pool of knowledge which has taken six years and over $2 million to develop. Techniques are steadily improved by continuing research.

Q. What is the WHIRLCLAD patent position?

A. Polymer Processes, Inc., a subsidiary of The Polymer Corporation, controls five issued U.S. Patents covering various aspects of the fluidized bed coating process (four of the five have issued in 1961). Over 40 additional patent applications are pending. Polymer Processes also has a licensing agreement with the right to sublicense covering patents and technical developments with Knapsack-Griesheim, a division of one of Germany's largest chemical companies, where this unique coating system was first developed.

Q. How are WHIRLCLAD licenses obtained?

A. They are available in either of two forms which meet most requirements. Both are free of down payments or minimum annual fees. In the simpler form, royalties are included in the cost of coating materials supplied by Polymer or other authorized sources. The second contract provides long-term guarantees for users considering major investments in equipment.

Q. Will licenses be available from sources other than Polymer Processes?

A. Yes. Polymer is instituting a program of education and technical assistance with a selected group of equipment manufacturers and coating material producers who will be able to issue licenses to their customers.

Q. How much are royalties?

A. Royalties are 5% of the cost of materials used in the patented process. This amounts to a negligible percentage of the sale price of finished articles—the customary basis for royalty calculation.

Q. Where can I get more information?

A. Technical literature; illustrated brochures of equipment, materials and methods; data sheets on tests and field performance—the results of years of research and development—are available on request through Polymer Processes. This group also evaluates equipment, handles licensing arrangements, and offers Systems Engineering Service to customers installing major coating lines. Special equipment, unique to the WHIRLCLAD System and not generally available elsewhere, is also sold through Polymer Processes. For more information, we suggest you contact us at your earliest convenience.

*TM Polymer Processes, Inc.

POLYPENCO®

POLYMER PROCESSES, INC.

A Subsidiary of The Polymer Corporation

Reading, Pennsylvania

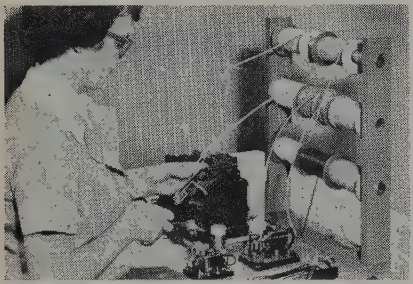
Print Ins. 33 on Reader Service Card

New Materials and Components

For further information on these products print the item number on the Reader Service Inquiry Card on the back cover. Fill out and mail the card—no postage is required. Insulation *will immediately forward your inquiry to the manufacturers concerned so that they can send you more information promptly.*

Pre-packaged Sleeving Assortment

A new pre-packaged assortment of ten 100-ft spools of insulating sleeving called "Mini-Pak" is designed for the "Ben Har" 1151 line of durasyl class H silicone rubber fiber glass insulation sleevings. To reduce inventories, the most used colors and sizes can be purchased in pre-packaged, economical small lots. By racking the individual Mini-Spools on spindles or rods, an easy access unit can be made to speed product assembly. Mini-Pak may be ordered in any combination of 10 standard colors, in all AWG sizes from No. 12 to No. 26 inclusive. Data sheets and prices are available. Bentley-Harris Manufacturing Co., 900 Barclay St., Conshohocken 6, Pa.



Print No. Ins. 101 on Reader Service Card

Continuous 250°C Operation for New "ML" Film-Coated Magnet Wire

A new film-coated magnet wire reportedly affords continuous high-temperature operation up to 250°C and resists heat shock up to 425°C. The exceptional heat stability of the new ML wire which makes it adaptable to high-temperature applications also provides for reduction in electric motor sizes. Because motors wound with ML can run hotter, over-all sizes can be reduced without sacrifice in horsepower rating. Another feature of the new product is cost savings in winding of relays since contact contamination due to outgassing is said to have been virtually eliminated. ML wire is said to have high chemical resistance, making it suitable for most types of encapsulated windings. Other advantages claimed are high burn-out resistance, a thermoplastic flow above 500°C, dry dielectric strength above 3,000 vpm, excellent flexibility, windability, and scrape resistance. ML magnet wire is suggested as a replacement for many film-coated and many glass or glass-"Dacron" coated wires in motors, generators, transformers, and many electronic applications. It is available in all sizes of round, square, and rectangular magnet wires. Single, heavy, triple, or quadruple films can be supplied. Anaconda Wire and Cable Co., Dept. 3B, 25 Broadway, New York 4.

Print No. Ins. 102 on Reader Service Card

UL Approved 'Teflon' FEP

New UL approved Teflon FEP insulated wire is said to be particularly good for use in back panelling in the manufacture of electronic data processing equipment and miniature circuitry, where strenuous demands are made on thin-walled insulated wires. The wire is rated for performance at 200°C (392°F), and its durability reportedly enables it to withstand virtually every known solvent. It is available in long lengths, in all standard colors with or without stripes, solid and stranded conductors, in gauges 20 through 26. Philadelphia Insulated Wire Co., New Albany Road, Moorestown, N.J.

Print No. Ins. 103 on Reader Service Card

Ceramic Material for Resistor Bases

A new ceramic material has been developed especially for use as a base for carbon deposited and metal film resistors. Designated Body 702, this material can be supplied in a wide range of diameters and lengths. Samples available. Ceramic Dept., Centralab, The Electronics Division of Globe-Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.

Print No. Ins. 104 on Reader Service Card

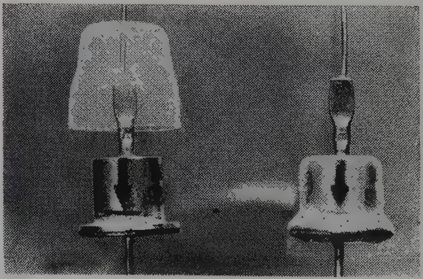
Color Striped Silicone Rubber Wire and Cable Insulation

A new process has been developed which is said to permit the production of silicone rubber insulation with multicolor markings that will not rub off and to allow many color combinations for multiconductor and single hook-up wire and cable. Color striped silicone insulation reportedly permits the use of smaller wires in multiconductor cables and results in lighter weight, extra flexible, reduced diameter cable. The smaller silicone insulated wires also eliminate braids which may be subject to fraying and moisture absorption. Color striped silicone rubber wire is available in AWG sizes 24 through 10. Boston Insulated Wire and Cable Co., 65 Bay St., Boston 25, Mass.

Print No. Ins. 105 on Reader Service Card

Instant Insulation For Semiconductors

Diode and transistor cases can be insulated in a matter of a few seconds through the use of pre-formed "Thermofit" heat shrinkable sleeving. This sleeving, available in several plastic materials, is cut and formed by the manufacturer to fit standard case sizes of semi-conductor devices. The formed sleeve, or preform, can be easily slipped into position over the



NOW AVAILABLE FROM A NEW RESIN SYSTEM

Made from an entirely new Richardson resin—the new "cold" punch NEMA XXXPC material has the following exceptional features:

- Good punching over a wide range of low temperatures
- Punching characteristics relatively unchanged after storage
- Good reproducibility
- Excellent solvent resistance
- Excellent electrical characteristics

RICHARDSON HAS TWO COMPLETE FABRICATING PLANTS—NEW BRUNSWICK, N.J., AND MELROSE PARK, ILL. Call your nearby sales office or write for technical data and samples (of copper-clad or unclad) to The Richardson Company, Dept. 14, 2693 Lake Street, Melrose Park, Ill.

RESOURCEFULNESS
RESEARCH
RESPONSIBILITY

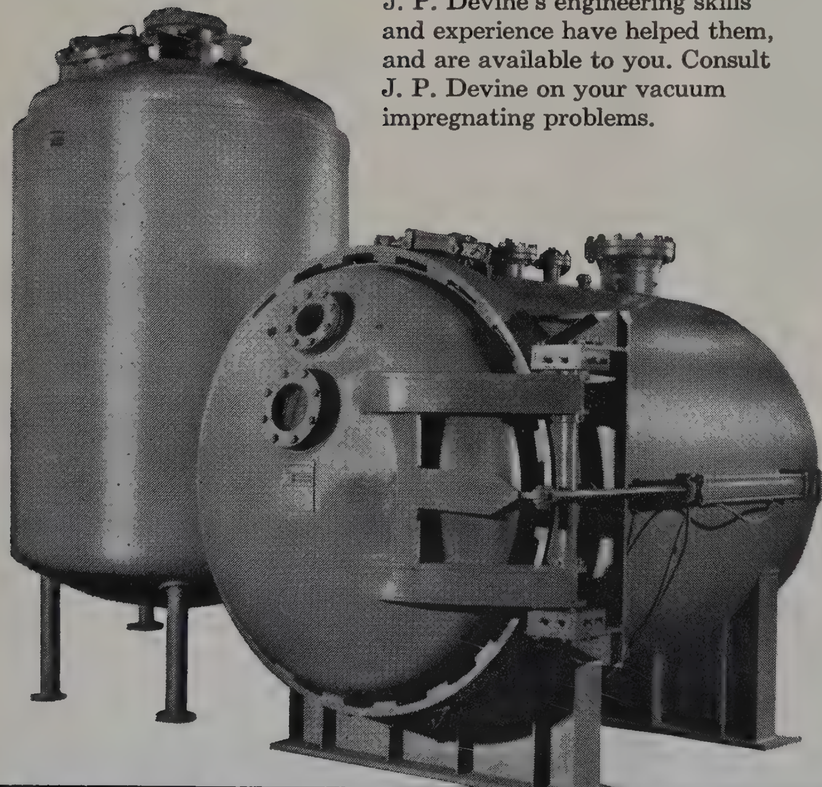
INSUROK® T-755...developed for Fabricated Parts like these

Print Ins. 34 on Reader Service Card

IMPREGNATING
with VARNISH?
EPOXY?
WAX?
PITCH?

No matter what your problem, to do the most economical, fastest and most fool-proof impregnating job, use J. P. Devine vacuum equipment. Devine, manufacturer of processing equipment for over 55 years, has an engineering staff ready and able to handle any of the intricacies of vacuum and pressure processing.

Shown below is a horizontal impregnating chamber with a vertical holding tank—designed for vacuum-pressure impregnating at 450° F. of low voltage coils with asphalt wax compound. Such outstanding features as the Devine air-operated, quick-opening door, the unit's adaptability to any product or process, its automatic controls, as well as its availability in single, sturdy platform construction—are some of the reasons why so many companies all over the world use Devine equipment. J. P. Devine's engineering skills and experience have helped them, and are available to you. Consult J. P. Devine on your vacuum impregnating problems.



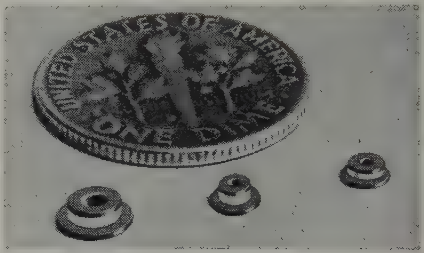
J. P. DEVINE MFG. CO.
A UNIT OF COX INDUSTRIES
49TH STREET & A.V.R.R. · PITTSBURGH, PA.
New York Office: 500 Fifth Ave., New York 36, N.Y. Phone: Wisconsin 7-7769; Export Office: 50 Church St., New York 7, N.Y. Cable Address: "Brosites"
Print Ins. 35 on Reader Service Card

case and then permanently locked into place by heating the lower part of the preform, causing it to shrink and form a skintight encapsulation without heating the case. Typical applications include those where there is a voltage on the semiconductor case or where the unit must be insulated for use in a modular construction. These preforms can be used wherever electrical or chemical insulation is required and are designed to encapsulate devices of virtually any shape. Rayclad Tubes Inc., Subsidiary of Raychem Corp., Oakside at Northside, Redwood City, Calif.

Print No. Ins. 106 on Reader Service Card

Ceramic Insulated Tunnel Diode Envelopes

New tunnel diode envelopes are fabricated of a high alumina insulator which is brazed to a flange on one end and to a pedestal on the other. Several sizes are in production, the smallest being .080″ OD and .030″ overall height, with concentricities of .001″. Uniform electrical characteristics and high reliability are major advantages cited. Prices are less than $1 in lots of 5,000. Ceramics International Corp., 39 Siding Place, Mahwah, N.J.



Print No. Ins. 107 on Reader Service Card

Butyrate Cable Clamps For Outdoor Applications

A new line of butyrate cable clamps are ultraviolet stabilized for weather resistance. The ½″-wide clamps, designated Type 6B, reportedly provide

excellent cable support and exceptionally long life even with continuous exposure to sunlight, moisture, industrial atmospheres, and temperature extremes. The butyrate formula used in the 6B clamps is approved under Mil L-P-349a, Type III—Class MH. Clamps are available from stock in clear color, for wire sizes from 1/8″ to 1½″. Bulletin 853 available. Weckesser Co. Inc., Dept. IN-2, 5701 Northwest Highway, Chicago 46.
Print No. Ins. 108 on Reader Service Card

Flexible Waterproof Adhesive

Reportedly believed to be the strongest flexible adhesive available today, CD Cement 350 is used for bonding natural and synthetic rubber, vinyl plastic, fabric, leather, and wood to itself or to glass, steel, iron, aluminum, phenolic plastic, and many other surfaces. It is said to be permanently flexible. Other qualities cited for the high solids adhesive include fast setting, extremely tough, waterproof, and resistance to oil, gasoline, chemicals, and outdoor weather. Applications are expected in public utilities for sealing or caulking purposes, and in the waterproofing of electrical systems. Bulletin available. Chemical Development Corp., Danvers, Mass.
Print No. Ins. 109 on Reader Service Card

Copper-Clad, Punching Grade, Flame Retardent Laminate Rated Class A

A new copper-clad, punching grade, XXXP-FR laminate is said to have excellent flame retardancy and low water absorption. Identified as "Cu-Clad" N-6009, the new laminate reportedly combines the high electrical properties of regular XXXP copper-clad laminates with excellent punching and machining qualities. It is de-

Order Your Copy of the Insulation Directory/Encyclopedia Issue Today – Only $10.00!

FOR THE FIRST TIME . . .

. . . all of the available basic information on insulation concepts, standards, materials, wire and cable, insulated components, test instruments, and production equipment has been brought together in a single volume.

INSULATION DIRECTORY/ENCYCLOPEDIA ISSUE . . .

. . . is the most complete treatment of the subject which has ever been published. It is a reference book (close to 350 pages) that all insulation engineers will want to keep within daily reach.

CONTENTS: Listing of Manufacturers, Converters, Fabricators, and Testing or Research Companies • Geographical Listing of Distributors and Agents • Tables and Formulas • Glossary • Insulation Standards, Concepts, and Applications • Gaseous Dielectrics • Liquid Dielectrics • Fibers, Cords, Twines, Lacing Tapes, and Untreated Felts, Mats, Woven Tapes, and Fabrics, Non-Adhesive • Treated and Untreated Papers and Boards • Treated and Untreated Vulcanized Fibre • Flexible Tubings, Sleevings, and Tubular Specialties • Flexible Coated or Treated Cloth, Felt, Mat, and Unidirectional Yarn Tapes and Sheeting (Not Self-Adhering) • Flexible Cloth, Film, Fiber, Mat, and Paper Composite Insulations • Pressure Sensitive, Adhesive, and Self-Adhering Tapes and Specialties • Plastic Resins, Molding and Extruding Compounds, Molded Products, Plasticizers, Fillers, Reinforcements, Additives, Etc. • Rubber and Elastomer Materials, Compounds, and Processed Shapes or Products • Solidifying Fluids, Pastes, and Powders for Coating, Impregnating, Embedding, Encapsulating, Potting, and Casting • Non-Supported Flexible Plastic and Rubber or Elastomer Films, Tapes, or Sheeting (Not Self-Adhering) • Reinforced and Laminated Plastic Sheets, Tubes and Rods, Copper Clad and Unclad, Plain and Composite • Mica Products • Ceramic and Glass Products • Printed and Molded Circuits • Magnet Wire • Wire, Cable, and Assemblies (except Magnet Wire) • Insulation Test and Measuring Instruments, Equipment, Methods, and Services • Production and Processing Equipment for the Conversion, Fabrication, or Use of Insulation • Miscellaneous Products

Lake Publishing Corp., Box 270, Libertyville, Ill.

USE THIS COUPON

Yes, send me (..................) copies of the first *Insulation Directory/Encyclopedia Issue* at $10.00 per copy plus postage (we pay postage if payment accompanies order).

Name..

Title..

Company..

Street Address..

City and State..

PLEASE PRINT

Print Ins. 36 on Reader Service Card

Tape so thin and flexible...it looks "POURED ON!"

e is a Johns-Manville Dutch nd Electrical Tape that is ex- right for insulating coil wind- and many other critical appli-ons. Called J-M Dutch Brand No. it is a flexible, stretchable poly- film only one mil thick . . . yet lielectric value of over 4500 volts ayer. Thus, it affords outstand- nsulating efficiency with mini- tape build-up!

oreover, No. 520 Tape remains e at operating temperatures up 5° C...has high tensile strength ear resistance . . . serves as an lent moisture vapor barrier... stands attack by oil, grease, icals and solvents.

e of 12 brand-new tapes for the electrical specialist, J-M Dutch Brand No. 520 Tape employs a thermosetting adhesive that does not lose holding power at high speeds. Its distinctive orange color makes for easy identification.

Get complete facts on the full line of Johns-Manville Dutch Brand® Tapes today from your Dutch Brand man. Or write Dutch Brand Division, Johns-Manville, Box 359, New York 16, N. Y. In Canada: Port Credit, Ontario. Cable: Johnmanvil.

Other J-M Dutch Brand Electrical Tapes for specialty applications, include . . .

No. 510 Paper Tape has thin, flat backing made of strong rope stock . . . conforms to irregular surfaces . . . thermosetting adhesive will not soften.

No. 523 Polyester Tape is similar to No. 520, except backing is two mils thick. Orange thermosetting adhesive . . . dielectric strength of 6500 volts.

No. 530 Woven Glass Cloth Tape for use where paper, cotton or plastic backing might fail. High tensile strength. Dielectric strength of 1500 volts.

No. 524 Clear Polyester Tape similar to No. 520, except one-mil film is clear and translucent. Thermosetting adhesive . . . dielectric strength of 4500 volts.

JOHNS-MANVILLE
DUTCH BRAND TAPES

JOHNS-MANVILLE JM PRODUCTS

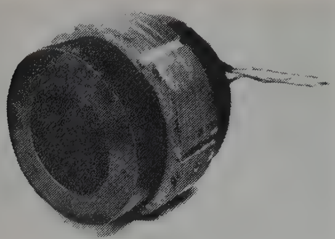
Print Ins. 37 on Reader Service Card

signed for use in 105°C (class A) applications. N-6009 meets the requirements for NEMA grade XXXP laminates as well as military specification Mil-P-13949B, type PP. Specimens of the new laminate, subjected to the standard flame retardancy test (ASTM D 635-56T), are reported to extinguish themselves 3 seconds after removal of the flame. It is available with 1-oz or 2-oz copper foil bonded to one or both sides. The laminate may be dip or float soldered without damage, it is stated, and the bond which joins the electrolytically-deposited copper foil to the laminate has high peel strength and is not affected by standard plating and etching solutions. Available in 36″ x 42″ sheets with a satin finish and ranging in thickness from 1/32″ to ⅛″. Also available without the copper surfacing. Price for the copper-clad sheet in quantities of 500 sq ft and over is $0.84 per sq ft, 1/16″ thick, with 1 oz copper on one side. The Mica Insulator Div., Minnesota Mining and Manufacturing Co., Schenectady 1, N.Y.

Print No. Ins. 110 on Reader Service Card

Easy-To-Use Motor Stator Protective Epoxy Compounds

Two new flexible, but tough, room temperature cured epoxy compounds have been developed to protect motor stator windings against moisture, dirt, abrasion, impact, chemicals, and other contaminants. Both products reportedly handle the shock typical in motor operations and come preweighed, de-aired, and ready to use.



Motor casting compound 10-063 is a two component material which hardens in 2-4 hrs. No varnish dip of the stator is needed. Motor butter 10-062 is a two component epoxy material which is thixotropic and which also hardens in 2-4 hrs. Bulletins MR-1 and MR-2 available. Hysol Corp., Olean, N.Y.

Print No. Ins. 111 on Reader Service Card

Metallized Mica

Metallized mica elements for resistive films for wave guide attenuators and strip film resistors, silvered micas for capacitor plates, and in fact, any mica parts metallized with any metal are now available. The metallized mica has been added to a complete line of cut, stamped, shaped, machined, and lathe turned micas. Micacraft Products Inc., 53 Liberty St., Newark 5, N.J.

Print No. Ins. 112 on Reader Service Card

Urethane Foam for Potting Electrical Components

A new potting material reportedly puts a minimum of stress on the parts being potted because the resulting urethane foam slowly and uniformly expands and hardens in the potting void. The nonfriable foam is cured to protect the parts embedded in it against shock, vibration, corrosion, and dampness. The potted foam has a density of approximately 10 to 12 lbs/cu ft, which is much lighter than conventional potting componds. The product is said to be ideal for potting electrical components. Foam is prepared by either batch or mechanical mixing of 100 parts by weight of "Chempol" 30-1322 resin and 118 parts of Chempol 30-1426 resin. This mixture is then poured into the void to be potted and allowed to foam and cure. Most foamed parts can be cured at normal room temperatures, but in some cases it may be desirable to cure the foamed part in an oven at 150°F for about ½-hr immediately after foaming is complete. The rigid urethane foam produced is also stated to have excellent dimensional stability at both low and elevated temperatures, to be unaffected by a series of thermal shock cycles from 200 to —67°F, and is not cracked or distorted by immersion in liquid nitrogen. Heat distortion temperature of the foam is above 200°F (ASTM D648). Other properties reported include a K factor of 0.25, tensile strength of 405 psi, shear strength of 103 psi, flexural strength of 128 psi, compressive strength at yield point of 375 psi, and a 6% deflection at yield. Freeman Chemical Corp., 222 E. Main St., Port Washington, Wis., or Dept. NA 76, National Aniline Div., Allied Chemical Corp., 40 Rector St., New York 6.

Print No. Ins. 113 on Reader Service Card

Strong Epoxy Adhesive

New epoxy adhesive is said to provide bonds to aluminum exceeding 5000 lbs/sq in and to offer exceptional adhesion to steel, copper, glass, porcelain, and various combinations of these materials. Also featured are toughness combined with excellent ductility, good resistance to chemical attack, and retention of strength even after 30-day immersion in water. It will cure in one hour at 300°F. Conap Inc., 184 East Union St., Allegany, N.Y.

Print No. Ins. 114 on Reader Service Card

Polyurethane Elastomer With Long Pot Life

"Urapol" 821A is a black polyurethane elastomer that is distinguished by unusually long pot life at room temperature. When cured, it is stated to have high tensile strength; resilience; excellent resistance to abrasion, compression set, oils, solvents, ozone, oxidation, and low temperatures; and remarkable tear strength. 821A is a compounded polyol blend which is reacted with a prepolymer, Urapol 800B in the proportion of 20 pbw of 800B to 100 pbw of 821A polyol. It is possible to mix manually or to use a slow speed mixer to blend the components. There is virtually no trapping of air by either method. Strict quality controls reportedly eliminate any tendency for gassing or blowing. Uses are expected in such areas as coatings, molds, encapsulating, potting, dip coating, and prototype products. Properties reported include: dielectric constant at 0.1 kc of 11.1 (75°F) and 12.57 (212°F), 9.41 and 10.8 at 100 kc; power factor at 0.1 kc of 2.15 (75°F) and 20.7 (212°F), 9.5 and 6.95 at 100 kc; volume resistivity (ohm-cm) of 4.3×10^{11} at 75°F and 2.9×10^{10} at 212°F; and dielectric strength of 450 vpm. Poly Resins, 11655 Wicks St., Sun Valley, Calif.

Print No. Ins. 115 on Reader Service Card

Non-Flammable, Solvent-Type Protective Coating for Electronics

A new, non-flammable, solvent-type

ENJAY BUTYL

best way to handle electricity

Enjay Butyl withstands all the common foes of electrical insulation — heat, water, corona, ozone, sun, weather, and high-voltage discharge. Because of its exceptional heat resistance, Butyl-insulated cable lets you carry a higher current with a given conductor size. Water absorption of Butyl insulation at 90°C is only about one-sixth that of conventional compounds, making it ideal for underground and underwater applications.

Butyl's high dielectric strength prevents excessive loss (with its resultant cable deterioration and increase in transmission cost); also guards against breakdowns due to surge currents. These characteristics have made Enjay Butyl the preferred rubber for insulation of power cable, transformers and bus bars. Coupled with outstanding abrasion resistance, these same characteristics point the way toward increased use of Butyl as a jacketing material.

For more information, write to Enjay, 15 West 51st Street, New York 19, New York.

ENJAY®
BUTYL

EXCITING NEW PRODUCTS THROUGH PETRO-CHEMISTRY
ENJAY CHEMICAL COMPANY
A DIVISION OF HUMBLE OIL & REFINING COMPANY

Print Ins. 38 on Reader Service Card

liquid coating, "HumiSeal" type 1B20, is a single-component, air-drying, solderable, acrylic-base coating suitable for printed circuit boards, data cards, and a wide range of other electronic applications. No special handling in either shipping, storage, or application is required. Type 1B20 dries and cures at room temperature where it becomes tack-free in 15 minutes and cured in 24 hrs, or it may be oven cured for 30 minutes at 80°C. This new coating is said to be suitable for operating temperatures up to 300°F (149°C) and down to —75°F (—59.4°C). Excellent resistance to moisture, corrosive gases, salt spray, fungus, and aging; excellent insulating properties; resistance to abrasion; and good adhesion are claimed. Pot life and shelf life at room temperature are six months. Columbia Technical Corp., 24-30 Brooklyn-Queens Expressway West. Woodside 77, N.Y.

Print No. Ins. 116 on Reader Service Card

Forming Board for Low Voltage Printed Circuit Substrates

A new kraft-type paper forming board is stated to be molded permanently under heat and pressure into the most complex shapes with unbelievable speed. The product, Form-L Board 200, may be less costly than all other asphalt-free forming boards and competitive with some grades of asphalt forming boards. The product in its present formulation reportedly gives good dimensional stability, can be easily printed or coated with a score of finishing materials, can be die-cut or perforated, holds its shape after forming, does not warp, and exhibits no cold flow or bleed characteristics. It will probably be suitable for a host of applications, including low-cost, low-voltage substrates for printed circuits. It is now available in thicknesses up to .250" and in tan or light brown colors. It can be converted to virtually any other color in a standard operation. The Mead Corp., 118 W. First St., Dayton 2, Ohio.

Print No. Ins. 117 on Reader Service Card

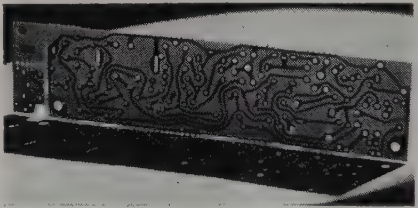
Low-Cost, Class H Laminate

A new NEMA grade G-7 laminate, designated Panelyte grade 132, is stated to offer the same quality and uniformity of existing G-7 grades, but to be manufactured and sold for less. The new laminate is produced by utilizing a new continuous filament glass cloth impregnated with a modified silicone resin. Extremely good dielectric loss and insulation resistance properties at normal operating conditions, and above average electrical properties under conditions of moisture and humidity are reported. Grade 132 is a class H insulating material said to have exceptional resistance to heat and arcing for a NEMA grade G-7 laminate. It meets the requirements of military specification Mil-P-997, type GSG, and is recommended for use in radio couplings and other electrical/electronic applications. It is said to be ideal for fabricating products of a semi-precision or less complex nature where both quality and cost savings are desired. Samples available. Dept. WMG, Panelyte Div., St. Regis Paper Co., N. Enterprise Ave., Trenton, N.J.

Print No. Ins. 118 on Reader Service Card

Printed Circuit Laminate Reduces Breakage, Improves Electricals

A new copper-clad laminate reportedly provides the high tensile, flexural, and impact strength of glass fibre reinforced plastic at a price competitive with paper-base phenolic circuit boards. In addition to virtually eliminating printed circuit board breakage, it is claimed that the glass reinforcement and resin system used in "Cimclad" provides superior electricals, including low loss factors, increased insulation resistance, and unusually low moisture absorption. The self-extinguishing material is also said to be easy to process and to cold punch well at room temperatures. Cimastra Div., The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.



Print No. Ins. 119 on Reader Service Card

Improved Clarity for Polycarbonate Resin

A new grade of polycarbonate resin designed for applications requiring clarity, "Lexan" 102, has the same physical, electrical, and chemical properties offered by previous grades in the resin line. Its improved clarity results from use of additives which mask the natural light amber color of the resin and prevent darkening during molding. Price is $1.30/lb in truckload lots. Other grades are available in a variety of transparent, translucent, and opaque colors. General Electric Co., Chemical Materials Dept., Pittsfield, Mass.

Print No. Ins. 120 on Reader Service Card

Extruded Shapes of Phenolic and Other Thermosetting Plastics

Phenolic and other thermosetting plastics are now being extruded in rod, tubing, and other shapes of highly complicated cross section in any length desired. Both physical and electrical properties are said to be substantially identical with those of items conventionally molded of the same materials.

The phenolic extrusions are expected to find major applications in market areas similar to those served by paper-based phenolic laminates. Some features reported include greater compressive strength, better electrical properties under wet conditions, and cost of only 50 to 75% that of laminated counterparts. Flexural strength is about two-thirds that of the reinforced material, but the extruded phenolic items have a very fine surface finish and a higher gloss than ones produced by any other method. It is also stated that tolerances of ±0.4% of cross section can be met and that curves can be introduced just outside the die. Both wood and mica filled "Bakelite" phenolic compounds have been extruded. York Industrial Plastics Inc., York, Pa.

Print No. Ins. 121 on Reader Service Card

Continuous Glass/Epoxy Laminates In Slit Coils or Fabricated Parts

Continuous glass/epoxy laminates

New...
From
CIBA Research

A Low Viscosity Epoxy Resin at lower cost

For Casting
Encapsulating
Potting
Impregnating

Plus these advantages . . .
pleasant odor
less skin sensitizing
lower vapor pressure
higher flexural strengths

CIBA
First in Epoxies

CIBA Araldite 507

Specifications

Viscosity, at 25°C., cps.	500—700
Epoxy Value, Eq./100 gm.	0.52—0.54
Weight per Epoxide (WPE)	185—192
Weight/Gal., lb.	9.4—9.6

Araldite® 507 is a new low-viscosity modifie epoxy resin. The modification, accomplished during manufacture, results in a liquid (epichlorohydrin-bisphenol A) epoxy resin i combination with a proprietary monoepoxid reactive diluent.
For further information on Araldite 507 wri

CIBA Products Corporation
Fair Lawn, New Jersey

C I B A

are now available in slit coils or fabricated parts. Excellent electrical properties, moisture and chemical resistance, and high strength-to-weight ratio are reported. They meet AIEE class F temperature rating and Mil-P-18177B specification. This material with integral "Mylar" facing is expected to find many applications in motors, transformers, and other similar fields requiring excellent high temperature insulation. Available in thicknesses from .007″ to 1/16″. Spaulding Fibre Co. Inc., Tonawanda, N.Y.

Print No. Ins. 122 on Reader Service Card

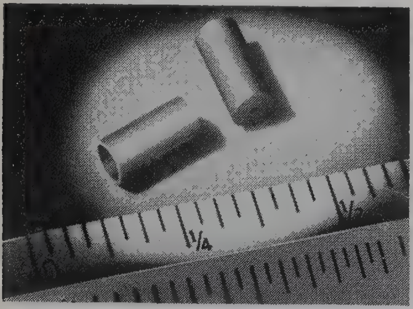
Flexible Coating for Laminated Plastics

Flexible Gel Cotes have now been developed for use on reinforced plastic laminates. New "Co-Rezyn" basic polyester resin formulation is claimed to be a quick curing, easy handling Gel Cote that has good gloss and hiding, as well as flexibility. A film of cured Co-Rezyn flexible Gel Cote cast on a piece of glass can be removed and rolled up like a piece of rubber. Other features reported include weather, scuff, and mar resistance; and the ability to withstand 24 hrs in boiling water. The material is transparent, and can be colored by addition of 2.5% by weight of any polyester color paste. Available also in colors. Commercial Resins Corp., 594 James Ave., St. Paul 2, Minn.

Print No. Ins. 123 on Reader Service Card

Miniature Diallyl Phthalate Cases For Electronic Components

Thin wall tubular and rectangular diallyl phthalate cases are now available in designs as small as .065″ OD × .055″ ID × .125″ long. Many other sizes and shapes can be molded on a custom basis. Several diallyl phthalate formulations are available, including glass fiber filled and "Orlon' filled stocks. The materials reportedly offer excellent electrical characteristics even after long term exposure to high humidity. Dimensional stability and superior moisture permeability are other important material characteristics featured. Possible applications include encapsulation of tantalum capacitors, silicon diodes, and many other types of miniature components. Epoxy resin can be used to seal the end openings to form a moisture resistant insulated assembly. Samples on request. Industrial Electronic Rubber Co., 31945 Aurora Rd., Solon 39, Ohio.



Print No. Ins. 124 on Reader Service Card

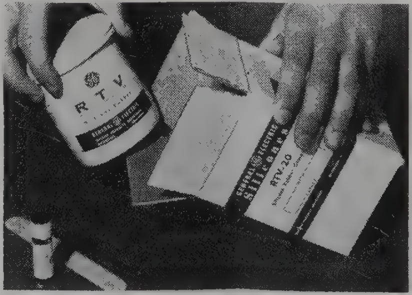
Miniature Insulators for Transistor Research

Miniature insulators for use in transistor research, dense alumina wafers .014″ thick, are currently being produced in .030″ square, .050″ square, and .070″ square sizes. The wafers are metalized and gold plated on both sides with no overlap on the thin edges. Excellent solderability of the wafers to transistor bases and of miniature components to the wafers is reported. Wafers have been made as small as .008″ thick by .018″ square. The cost for standard sizes is 75 cents each in quantities below 500. Ceramics International Corp., 39 Siding Place, Mahwah, N.J.

Print No. Ins. 125 on Reader Service Card

RTV Silicones in Smaller Quantities

RTV (room temperature vulcanizing) liquid silicone rubber compounds for electrical insulating uses are now available in single-pound quantities from G-E for the first time. Available in these quantities are six grades—RTV-11, 20, 40, 60, 88, 90, offering users a choice of consistencies in uncured form all the way from easily pourable to stiff paste. Price of 1 lb orders ranges from $6 to $7.50/lb (catalyst included). These materials find wide use as encapsulating, potting, sealing, and caulking compounds, providing thermal and electrical insulation to various components as well as protection from the elements. They are also used as a flexible mold material. Silicone Products Dept., General Electric Co., Waterford, N.Y.



Print No. Ins. 126 on Reader Service Card

Glass/Epoxy Laminate for Military Electronics

A new "Textolite" copper-clad glass/epoxy laminate (grade 11584) can be certified to meet the requirements for copper-clad G-10 and G-11. Grade 11584 was developed to withstand the severe mechanical and thermal shock encountered in critical electronic applications in missiles, radar, aircraft, sonar, and other military instrumentation. Outstanding features reported include retention of 50% of its room-temperature flexural strength at 150°C and 50% of the copper bond strength after seven days aging at 325°F. Also, the excellent machinability of NEMA G-10, plus good transparency, and extreme resistance to solvents and etching solutions. It satisfies Mil-P 13949B for both type GB and type GE. Laminated Products Dept., General Electric Co., Coshocton, Ohio.

Print No. Ins. 127 on Reader Service Card

Extruded 'Teflon' Sheets

Extruded sheets of Teflon may now be obtained in sizes from ¼″ to 1″ thick by 6″ wide and up to 10 ft long. The material is also available in continuous lengths. Widths up to 24″ will be available soon. Tri-Point Industries Inc., Albertson, L.I., N.Y.

Print No. Ins. 128 on Reader Service Card

1000°F Magnet Wire

A new ceramic insulated magnet wire is claimed to be the first practical, flexible, and reliable magnet wire for 1000°F service. General Cable Corp., 730 Third Ave., New York 17.

Print No. Ins. 129 on Reader Service Card

Cord and Cable for Hot Spot Problems

New line of high temperature cables

THERE ARE JOB-ENGINEERED DIFFERENCES IN EVERY CLASS OF

ESSEX

FILM COATED

magnet wire

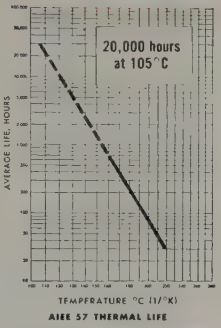
There's a "right-wire" for you in this full Essex line. Each one has job engineered differences specifically developed for your applications. Selecting the proper Essex magnet wire will assure you of greater efficiency . . . with minimum trouble and down time. Some of the differences and applications are typified in the examples given below.

Enamel Class 105C	Formvar Class 105C	Acrylic Class 105C	Modified Formvar Class 105C	Self-Bonding Formvar Class 105C	Nylon Class 105C	Formvar-Nylon Comb. Class 105C	Urethane Class 105C	Non Slipping Urethane Class 105C	Urethane-Nylon Comb. Class 130C	Self-Bonding Urethane Class 105C	Epoxy Class 130C	Mod. Polyester Class 155C	Silicone Class 180C	ML* Class 220C
Plain or Black Enamel	Formvar	Acrylex	Formetex	Bondex	Nylon	Nyform	Soderex	Gripex	Soderon	Soderbond Soderbond N	Epoxy	Poly-Thermalex Nytherm Thermalex F	Silicone	Allex

FORMVAR

Service record unequaled in wire industry assures years of trouble free service. Size range—round wire 4 through 52 single, heavy, triple, quadruple. Squares and rectangles up to 100,000 square mils.

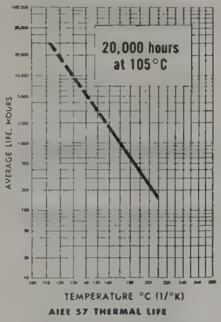
Applications: Class A motor windings, round wire coils of all types, hermetic applications when hermetic grade specified, shaped wire coils, oil filled transformers.



NYFORM

The complete dependability of Formvar with a plus factor in windability. Size range—round 4 through 44 single, heavy, triple, quadruple.

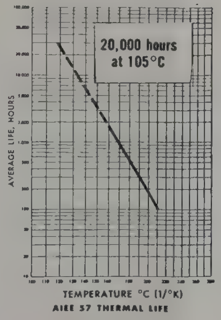
Applications: High speed motor windings, hand tool motor armatures, Class A coils and transformers of all types. Particular adaptability where overload resistance is required.



SODEREX®

Solderable without film removal. Size range—10 through 52 single, heavy, triple, quadruple.

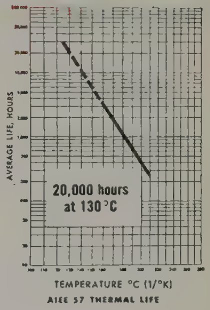
Applications: Electronic coils, light duty motor and armature windings, transformer coils, relays. The correct choice for a product requiring solderability without stripping in the finer wire sizes. Particularly recommended for solderable insulation on sizes 28 and finer.



SODERON®

Combines the features of Soderex with exceptional windability. Size range—4 through 44 single, heavy, triple, quadruple.

Applications: Light duty stator and armature windings, transformers, relays, coils. Particularly recommended for 27 and heavier wire where solderability is a requirement.

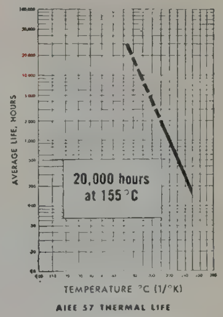


POLY-THERMALEX/PTX

A Class F magnet wire at Class A prices offering machine windability. Size range—4 through 40 single, heavy, triple, quadruple. Squares and rectangles up to 100,000 square mils.

Applications: General purposes—motors Class A through F, dry type transformers, relay coils. An excellent replacement for glass fabric wire.

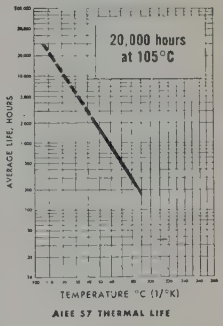
Licensed Under Patents Pending



PLAIN ENAMEL

Premium wire at a reduced cost for coil work. Size range—10 through 52 single and heavy.

Applications: Relays, paper section coils, power transformers, low voltage automotive coils. Will not exhibit resistance to physical abuse associated with synthetic films.



**E. I. duPont De Nemours & Co.—Type ML Resin.*

For your magnet wire planning contact Essex for instant assistance

SX®

MAGNET WIRE DIVISION

ESSEX WIRE CORPORATION
Fort Wayne, Indiana
National Network of Warehouses and Sales Offices

Print Ins. 40 on Reader Service Card

is designed to solve hot spot problems where intense heat has previously critically curtailed the life of the cable. The portable cords utilize a special butyl insulation with a butyl jacket. Control and power cables in the stationary product line use the special butyl insulation with an asbestos braid jacket. Designated Hot Spot Securityflex, intensive field trials have already been given various types of the new cable with the following conclusions reported: 1) The portable cable construction could be rated at 125°C. 2) It has at least two to three times the service life normally expected of standard portable cables in high temperature applications. 3) It can be manufactured in the same size range as standard products at a comparable cost and utilizing the same equipment. 4) It is adaptable to many high temperature applications. Dept. EFL-P5, Anaconda Wire and Cable Co., 25 Broadway, New York, N.Y.

Print No. Ins. 130 on Reader Service Card

Electrical Insulation Putty

A new electrical insulation putty known as Slipknot filler tape can be molded by finger pressure to make a homogeneous mass of insulation around connectors on cables and wires. With a dielectric strength of 500 vpm, the black tape is 125 mils (⅛″) thick. It is packed in 1½″ wide rolls, 60″ long, with parchment paper separator. Dissipation factor at 60 cycles of .09, dielectric constant of 3.0, insulation resistance of 1.5×10^7 megohms, and no copper or silver corrosion are reported. It is designed for use under a vinyl electrical tape. Tape Div., Plymouth Rubber Co. Inc., Canton, Mass.

Print No. Ins. 131 on Reader Service Card

Improved Nylon Coating For Wire and Cable

A new general purpose resin developed primarily for extrusion wire coating is known as "Zytel" 53 nylon resin. Used in test installations for about a year, it previously bore the marketing designation of FE-2386. Excellent stability, improved weatherability, and greater flexibility than former compositions are claimed. Weather-Ometer tests reportedly show that the material has twice the weatherability of other natural colored resins, suggesting its use in applications where transparency and resistance to occasional sunlight are requirements, such as in jacketing over color-coded primary insulation. Other properties reported include strength in thin sections, abrasion resistance, light weight, form stability at high temperatures, chemical resistance, and toughness over a wide range of temperatures. Some typical uses include insulation for hook-up, gas station, electric blanket, building, radiant heating, and automotive ignition wires, and for control cables. Transparancy also makes it useful in a number of molding applications. E. I. du Pont de Nemours & Co., Wilmington 98, Del.

Print No. Ins. 132 on Reader Service Card

Flame-Resistant Epoxy/Glass Laminate

A new "Textolite" self-extinguishing, epoxy/glass laminate is available in both standard and printed circuit copper-clad varieties. Designated number 11587, the new FR-4 laminate reportedly has good machining properties and excellent electrical properties under humid conditions. The copper-clad laminate is said to be resistant to chromic acid etching. Both the standard and the copper-clad laminates are available in 36″ × 36″, 36″ × 48″, and 36″ × 72″ sheets. The copper-clad laminate has a thickness range of .010″—.250″, while the standard laminate has a range of .010″—1″. Laminated Products Dept., General Electric Co., Coshocton, Ohio.

Print No. Ins. 133 on Reader Service Card

5000°F Insulating Cement

A new heat insulator is expected to find wide usage as thermocouple insulation and castable shapes. Unlike most refractory ceramics, S100-M material does not require high temperature kilns for processing. A dry ceramic powder is simply mixed with a supplied liquid to form a homogenous paste. This paste then dries and cures at room temperature. The cured cement reportedly has a melting point slightly above 5000°F. Weight of only 2 g/cc also makes this insulator ideal for rockets and missiles. The hardened cement can be machined to close tolerances. Semicon of California Inc., 70 Mariposa Ave., Watsonville, Calif.

Print No. Ins. 134 on Reader Service Card

Glass-Bonded Mica Insulators Have Low Loss at High Frequencies

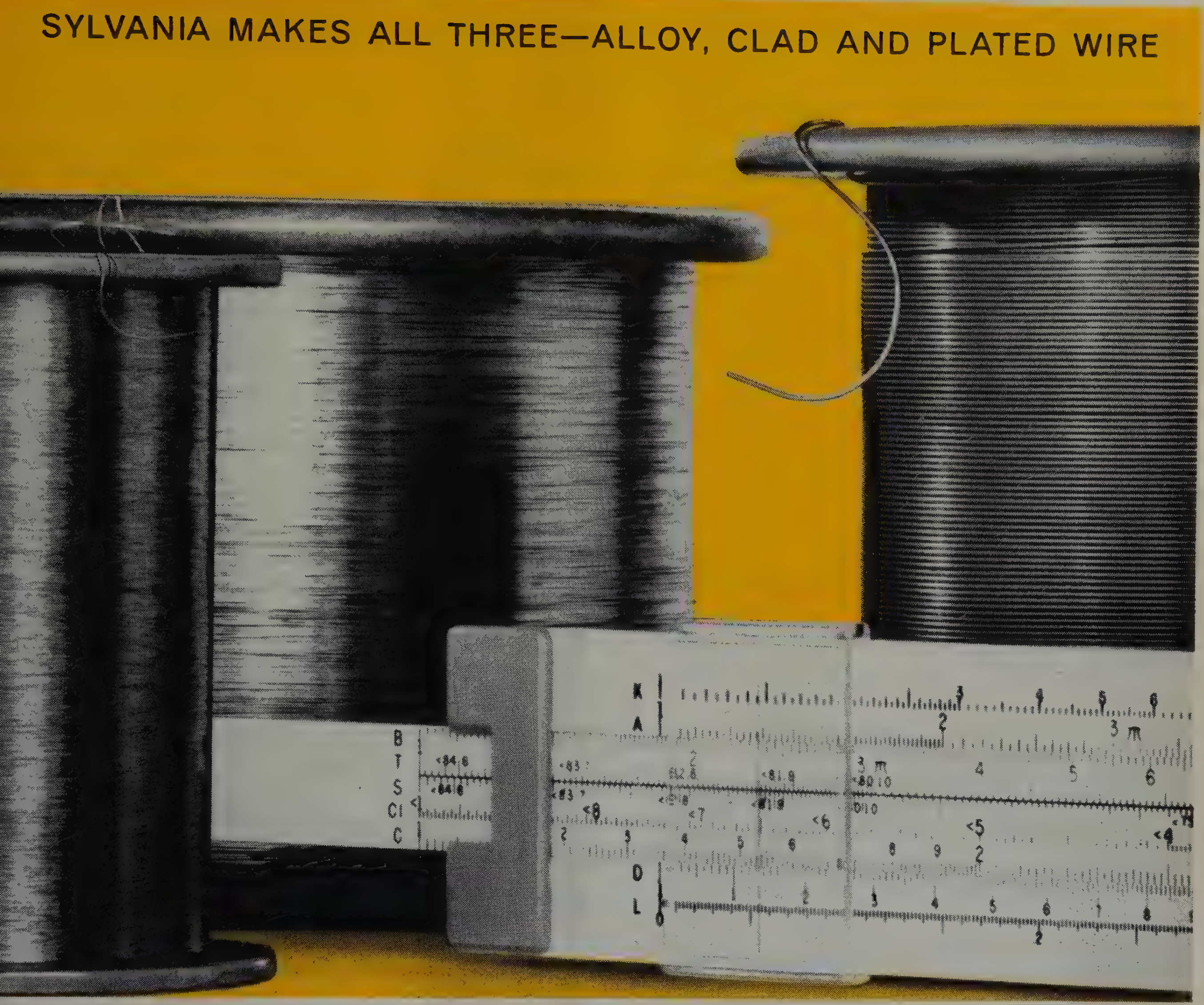
Recently completed tests and the assembly of new data are said to establish two grades of "Mykroy" glass-bonded mica as excellent low loss insulators at high frequencies. The two grades are Mykroy 750 and 1100, conforming to Mil-I-10A-L443 and Mil-I-10A-L442 respectively. Machineability, low-loss characteristics, rigidity, and complete freedom from moisture absorption reportedly make the material particularly useful as a high frequency insulator in place of fluorocarbon type plastics. It is virtually the only inorganic insulation which is freely machineable with carbide cutting tools and standard grinding facilities. Available in sheets, rods, and bars for fabrication. Company also machines, molds, and metalizes Mykroy to customer specifications. Capacitance coupling devices, microwave insulation, feed-through and stand-off insulation, switch mechanisms, commutators, and conductor support insulation are among the suggested applications. Electronic Mechanics Inc., 101 Clifton Blvd., Clifton, N.J.

Print No. Ins. 135 on Reader Service Card

High Temperature, Homogeneous Electrical Insulation Systems

A new high temperature electrical insulation system, based on a polymer experimentally known as Polymer ML, reportedly offers a unique combination of properties aimed at solution of insulation problems throughout the electrical industry. The family of materials, providing a homogeneous insulation system, includes wire enamels, coated fabric space insulations, and insulating varnishes. Significant properties indicated by labo-

SYLVANIA MAKES ALL THREE—ALLOY, CLAD AND PLATED WIRE



One way to conserve engineering time

—get an unbiased recommendation on wire from Sylvania

Rapid changes in high-temperature equipment plus the continued evolution in components mean this: it doesn't pay to get mired down by noncreative engineering details. Example: which wire to use to meet conductivity needs in corrosive or oxidizing atmospheres?

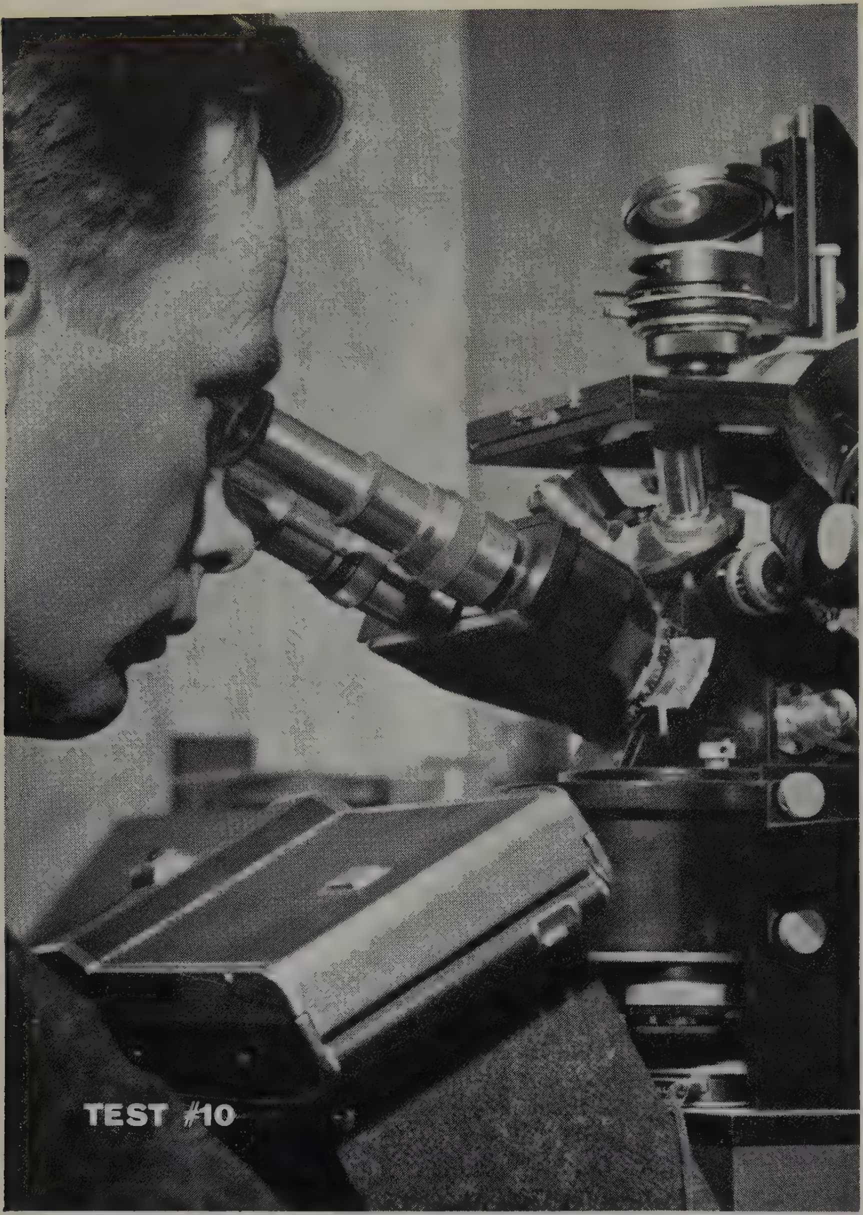
To make the most of your engineering time, call on *Sylvania* to help you with wire specs. Sylvania knows wire—and the particular advantages of each kind. Of all major manufacturers, only Sylvania makes all three types of bare wire—alloy, clad and plated. They're available in a complete range of sizes—.002″ to .250″. Each retains optimum characteristics up to recommended operating temperatures.

You know that a Sylvania recommendation will be objective, based on your needs, and not limited by what the supplier can supply. Full details—plus time saving help—are yours when you write Sylvania Electric Products Inc., Parts Division, Warren, Pennsylvania.

SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS**

Print Ins. 41 on Reader Service Card



44 Tests Show
This Capacitor Tissue's Best

This Crocker, Burbank technician is looking into the guts of our capacitor tissue, studying the length, width and distribution of the fibers.

This visual check of fiber size assists us in controlling the "beating" or hydration of the pulp to produce tissue with the optimum electrical and mechanical properties.

Just one of the 44 different tests (and thousands of individual readings) made on CBP tissues and raw materials, it is your assurance of uniformly good electrical, chemical and mechanical properties.

Certainly the most tested capacitor tissues in the world, CBP tissues are available in a wide range of grades from low to high density, with uniformly high purity and low power factor.

CROCKER,
BURBANK
PAPERS Inc.
FITCHBURG, MASS.

CAPACITOR TISSUE • CABLE INSULATION • MAJOR INSULATION • SATURATING KRAFT

Print Ins. 42 on Reader Service Card

ratory and field tests include: excellent thermal stability, with an expected life of more than 10 years at 200°C, more than two years at 250°C, several months at 300°C, and for shorter periods at 400 to 500°C; electrical properties are excellent and remain essentially unchanged from room temperature to over 250°C; solvent resistance is outstanding, and there is at present no known solvent for cured Polymer ML; the wire enamel will not "cut through" at 500°C when subjected to standard cut-through tests; radiation resistance is excellent (little change in the materials during radiation with 3,000 megarads of 2 mev electrons); moisture resistance is excellent (electric strength exceeds 2,000 vpm when the materials are wet, and insulation resistance is more than 500,000 megohms after boiling in water for 10 minutes); and the cured insulation will not support combustion. E. I. du Pont de Nemours & Co., Fabrics and Finishes Dept., Wilmington 98, Del.

Print No. Ins. 136 on Reader Service Card

Transformer-Circuit Breaker Oil With Better High Heat Transfer And Low Temperature Flowability

An improved transformer-circuit breaker oil is stated to have a 300°F flash point, better heat transfer ability at high temperatures, and better flowability at low temperatures. Improved refining techniques reportedly have enabled raising of the flash point of grade A-HT oil without disturbing low 58 SUS/100F viscosity. Good dielectric properties (including excellent resistance to electrical stress), better oxidation stability, and a low-temperature viscosity of 280 SUS/32F are claimed for the new product. Sun Oil Co., 1600 Walnut St., Philadelphia, Pa.

Print No. Ins. 137 on Reader Service Card

Vulcanizable Polyethylenes for Wire and Cable Insulation

Two new wire extrusion compounds, vulcanizable polyethylenes, offer a combination of improved physical and thermal properties for insulation and jacketing. Immediately after the extrusion operation these materials are chemically crosslinked by passing the insulated wire or cable through a continuous vulcanizer. Thermoset properties are imparted to the compounds—it is reported that dimensional stability at elevated temperatures is improved and that stress-cracking is eliminated. At the same time, the excellent abrasion and impact strength, tensile strength, chemical resistance, aging and weathering over a wide temperature range, and other desirable properties of conventional polyethylene are retained. HFDA-4201, in natural and colors, is designed for use as primary insulation in high voltage cable. A second compound, HFDA-4203, is said to provide an optimum balance of physical properties and flexibility for line wire and service drop insulation. Light weight and small diameter result in easier handling and allow the use of longer spans compared to thermosetting rubber materials. The materials reportedly offer substantially increased life under extreme service conditions. It is expected that operating temperatures as high as 90°C will be possible. Price is competitive with conventional polyethylene. Union Carbide Plastics Co., Div. of Union Carbide Corp., 270 Park Ave,, New York 17.

Print No. Ins. 138 on Reader Service Card

Flame Resistant Electrical Barrier Material for Punching and Forming

A new, low cost, flame resistant mechanical and electrical barrier material is designed for flat punching or formed parts. The material, "Duroid" 100FR, in .062″ thickness reportedly extinguishes itself in zero seconds according to the UL vertical test; .031″ gauge is self-extinguishing in six seconds. Duroid 100FR is also said to offer high tensile and bursting strengths, good ply adhesions, and excellent dielectric strength when dry (fair when wet). Available as sheet or fabricated forms in gauges of .031, .062, .093, and .125 inches. Rogers Corp., Rogers, Conn.

Print No. Ins. 139 on Reader Service Card

ATRC Cable Rated 300 V

A new ATRC cable is designed for use in telemetering, automatic relays, communications circuits, and supervisory control systems. Rating is 300 volts. It is also said to be particularly

SILICONE RUBBER ELECTRICAL TAPE

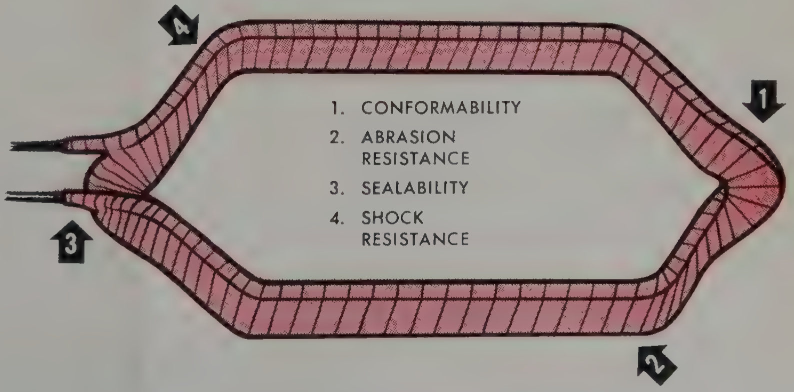
CHR offers a complete line of silicone rubber insulating tapes manufactured to meet your most demanding specifications.

UNSUPPORTED TAPES: Triangular and rectangular, self-adhering silicone rubber tapes. Triangular tape has a color line at the apex for uniform half-lap winding.

SUPPORTED TAPES: Cured, semi-cured, self-adhering, and uncured silicone rubber tapes in various thicknesses and base fabrics.

AVAILABILITY: From stock in various widths and thicknesses. Special constructions made to order.

Write today for complete CHR Electrical Tape data folder.



ELECTRICAL AND INDUSTRIAL SPECIALTY TAPES

CHR **CONNECTICUT HARD RUBBER CO.**

Main office: New Haven 9, Connecticut

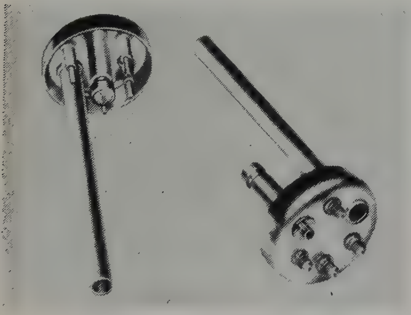
Print Ins. 43 on Reader Service Card

adaptable for aerial, duct, and direct burial use by pipe line companies, public utilities, railroads, and industrials. Specifications CS 237-1 available. Dept. EFL-P9, Anaconda Wire and Cable Co., 25 Broadway, New York City.
Print No. Ins. 140 on Reader Service Card

Plating on 'Teflon' Materials

A new development allows the plating of conductive metals such as copper, gold, and silver on machined or molded Teflon parts. Method can be used in the manufacture of assemblies which require circuitry on Teflon. Thos. A. Murphy Co., 11568 S. Los Angeles St., Orange, Calif.
Print No. Ins. 141 on Reader Service Card

Ceramic Multi-Terminal Traveling Wave Tube Base



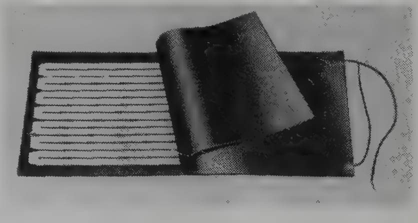
Multi-terminal bases for traveling wave tubes consist of a nickel cup supporting ceramic-to-metal tubular feed-throughs, together with an integral ceramic-to-metal input adaptor and copper evacuation tube. The number of feed-throughs varies from 4 to 8 depending on the electron tube involved. The number of simultaneous braze joints made with copper or alloys of gold varies up to 19. The ceramic-to-metal tube base components are metallized by a special method which is said to substantially reduce subsequent production failures in the manufacture of the end product. Brazing is accomplished on ceramic jigs in such a way that the electrical characteristics of the end product closely match those of the ceramic used. The tube bases are also stated to be rugged and to withstand repeated welding operations and a bake-out in air at 700°C for 72 hours without leaking. Ceramics International Corp., 39 Siding Place, Mahwah. N.J.
Print No. Ins. 142 on Reader Service Card

Plastic Electrical Conduits

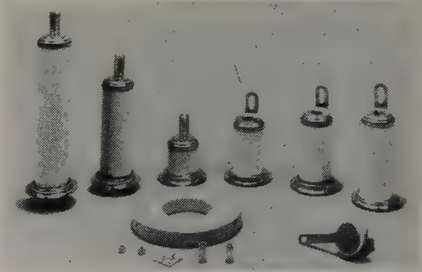
Two new low-cost plastic conduits have been labeled E/C electrical conduit and PVC electrical conduit. E/C is designed for general underground industrial wiring and commercial lighting applications and is available in 2″ to 6″ sizes. The PVC conduit is for general use in the corrosion-proof protection of wiring. It is manufactured in ½″ through 6″ sizes. The two new products are said to be completely corrosion resistant, to offer total protection against water leakage, to have smooth bores, and to be easy to handle, assemble, and install because of their light weight. Consolidated Pipe Co., 1066 Home Ave., Akron, Ohio.
Print No. Ins. 143 on Reader Service Card

Etched Foil Laminated In Insulation Sandwich

A new type of construction, utilizing resistance alloy foil etched to shape is now being used to manufacture flexible electric heater blankets. After etching, the foil is laminated in neoprene, epoxy, or silicone rubber to make a thin, waterproof, and extremely rugged blanket that meets MIL and UL specifications. The etched circuit is said to reduce overall costs significantly while offering improved thermal characteristics. Wide bands of foil reportedly provide more uniform heating, longer life, and higher watt densities than possible with comparable wire types. Blankets as large as 30 ft by 10 ft are in use for curing plastics, and adhesives. Foils as small as 1″ x 3″ are etched and laminated in "Teflon" for very thin, high performance heaters of electronic components. "Heat Sheets" are available in any desired size, shape, wattage, and voltage (up to 480 volts, three phase). Resistances as low as 0.1 ohms/sq ft are obtainable. Cut-outs and holes may be provided as required without tooling costs. Leads can be brought out together or at any point on the periphery, and thermostats, two-prong plugs, or quick-connect terminals can be provided. The heaters may be bonded in place, mechanically held, or fastened with hooks, snaps, or eyelets. Thermal Circuits Inc., 59 Park St., Beverly, Mass.
Print No. Ins. 144 on Reader Service Card

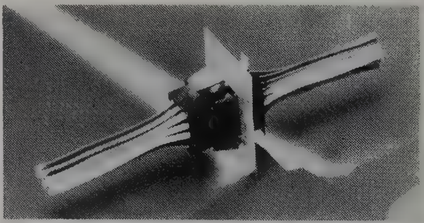


Ceramic Bases for Electronic Components Resist 1000°C



High temperature metalized ceramic bases may be used for mounting electronic components such as resistors, diodes, transistors, and capacitors. Advantages claimed for the dense, high strength alumina ceramic base are: It offers a miniaturized package more rugged than other dielectric materials now commercially available; and it permits useful temperature limits on the order of 1,000°C. The metalized ceramic bases are composed of alumina ceramics ranging in purity from 85% to 96%, with a high temperature metal coating, nickel plated to permit the user to silver braze or soft solder the closure. Metalizing Industries Inc., 338 Hudson St., Hackensack, N.J.
Print No. Ins. 145 on Reader Service Card

Phenolic Molding Compounds for Multiple Plugs and Receptacles



Phenolic molding compounds, used in the manufacture of multiple plugs and receptacles, reportedly offer outstanding physical and electrical properties and improved resistance to temperature and humidity extremes in multiple circuit wiring. Applications are currently found in appliances, electronic equipment, vending machines, automotive and allied industries, and other fields. Durez Plastics Div., Hooker Chemical Corp., Niag-

SILICOLOGY *Studies in Silicones*

HOW THESE TIME-TESTED MATERIALS CAN WORK FOR YOU

Silicone Insulation Insures Reliability—And You Can Afford This Economy Compound

The reliability that silicone rubber insulation affords is a sales feature no appliance manufacturer proud of his reputation can ignore. Today, he can get this reliability at surprisingly low cost if his wire supplier utilizes UNION CARBIDE K-1357 "Direct Feed" Silicone Rubber Compound.

The sales-conscious manufacturer knows that customers are demanding *quality* . . . but he also knows that the "cost-squeeze" is on. Silicone rubber provides this quality for modern electrical appliances, and K-1357 is a specially formulated silicone rubber that can be purchased and processed with a steely eye toward the cash register.

WHAT DOES IT ACCOMPLISH?

Continental Wire Corporation of Wallingford, Conn., a leading manufacturer using K-1357, sums it up. They make over 100 types of insulated wire for uses ranging from Alaskan communications to home appliances. To Continental, K-1357 means good insulation properties that match exacting military and commercial requirements . . . means reliability that helps their customers obtain good will for their products . . . and means production economies that can be passed along.

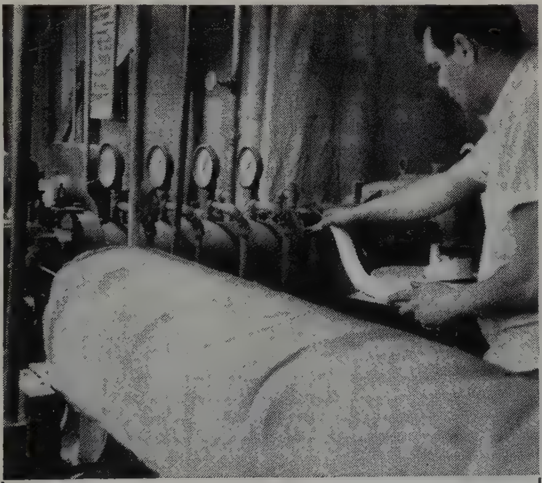
Added reasons why it's good business to do business with versatile K-1357 Silicone Rubber: It is available catalyzed or uncatalyzed, in sheet form. But of particular convenience to companies like Continental, it is also available in coiled strips which feed directly onto their extruders without need of milling and plasticizing. It can be braided without postcure. Either HAV or CV cures can be utilized effectively. The extruded rubber has high-gloss finish, is smooth and nonporous.

Incidentally, K-1357 also extrudes well as tubing, sealing strips, and complex shapes. It can be continuously vulcanized in steam or hot air, on conventional equipment. It can also be compression molded.

THREE-WAY BENEFITS

First, appliance manufacturers, second, designers in electrical and electronics fields, and third, wire manufacturers—all three can benefit from the superior physical and electrical properties of K-1357. Especially from its economies, of which a premium element is its nonpremium price.

Behind this and many other UNION CARBIDE Silicones are the vast experience and research of Union Carbide Corporation in virtually every field of industry. For information and help, send in the attached coupon today.



Direct-feeding UNION CARBIDE K-1357 Silicone Rubber compound into extruder at Continental Wire Corp. Compound is furnished in coiled strips, needs no milling or plasticizing. Low in first cost, economies multiply.

Typical Electrical Properties on Wire*

K-1357	Insulation Resistance**, Megohms/1000 feet			
	HAV Cured		CV Cured	
State of Cure	24 hr. immersion	30 day immersion	24 hr. immersion	30 day immersion
Initial Cure	5,000	7,000	2,500	3,500
Postcured 1 hr. at 300°F.	8,000	8,500	4,500	5,000
Postcured 4 hrs. at 400°F.	12,000	12,000	8,000	8,000

*No. 18 AWG, 7 x 0.0152, 16 mil wall, silver coated copper wire, 60°F. water, 5 minute electrification (500 volts)

**To convert to Insulation Resistance Constant (K factor) multiply by 4.2

Print Ins. 44 on Reader Service Card

UNION CARBIDE

SILICONES

UNION CARBIDE is a registered trade mark of Union Carbide Corporation.

Silicones Division
Union Carbide Corporation
Dept. II-9104, 30-20 Thompson Avenue,
Long Island City 1, N. Y.
In Canada: Bakelite Division,
Union Carbide Canada Ltd., Toronto 12.

Please send me data on new UNION CARBIDE K-1357 Silicone Rubber.

NAME ____________

TITLE ____________

COMPANY ____________

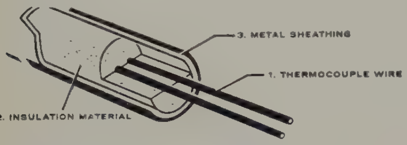
ADDRESS ____________

CITY ________ ZONE ____ STATE ____

ara Falls, N.Y.
Print No. Ins. 146 on Reader Service Card

Ceramic-Insulated Thermocouple For Electrical/Electronic, Other Uses

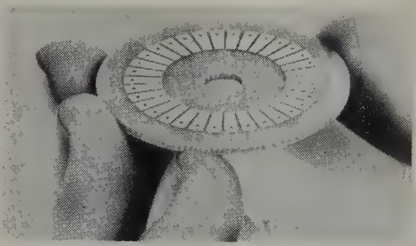
A highly versatile, ceramic-insulated, metal-sheathed, and spectrochemically clean thermocouple material designated "Tempak" reportedly provides maximum protection in conditions where corrosion, high pressure, severe vibration, and extreme temperatures are present. Tempak is manufactured for ordinary electrical leads, with single or multiple conductors, and is said to be especially suited for use in corrosive media and gases such as liquid oxygen, hydrogen peroxide, kerosene, oil, alcohol, and fatty acids. It is also stated that it can be coiled or bent on a radius as small as its own diameter; that it slips easily into inaccessible places; that its compact ceramic insulation will not 'powder;' and that its accurately centered wires will not short-circuit. Tempak can be supplied as part of a thermocouple assembly ready for installation, with the appropriate hot junction, mounting, bushing, connection head, and other components. Or, purchased by the foot, it is available in standard lengths of 35′ to 37′ random, as well as continuous lengths up to 100′. Temptron Inc., 7030 Darby Ave., Reseda, Calif.



Print No. Ins. 147 on Reader Service Card

Flush Circuit Devices

New material and manufacturing techniques are said to eliminate problems and limitations of former flush circuit devices. "Permadisc" circuit is reported to offer extreme hardness, durability, minimum outgassing, and extreme flushness with only .0001″ height difference between commutator conducting and nonconducting sections. This keeps electrical brush from skipping or jumping while rotating—with no electrical noise at 50 rpm. It has withstood operating temperatures at —65°C to +125°C; the commutator withstood 2,200,000 complete revolutions of a .062″ wide, flat brush rubbing along its surface at 50 rpm with a normal pressure of 12 to 15 grams. Precision Circuits Inc., 87 Weyman Ave., New Rochelle, N.Y.

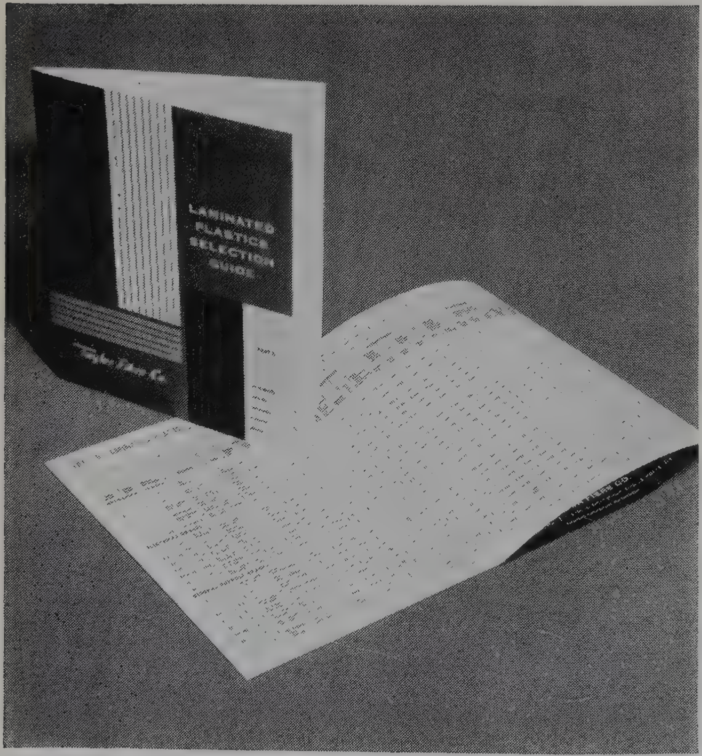


Print No. Ins. 148 on Reader Service Card

Heat-Reflective Tape Protects Wire Harnesses and Components

A pressure-sensitive tape with unusual heat-reflecting properties, known as PD-455, has been developed to protect missile components from the intense radiant heat generated during blast-off. These temperatures sometimes reach 5000°F and higher for short intervals. Due to the light weight and high conformability of PD-455, it has found additional use as a heat shield for wire harnesses and other vital hardware during flight. PD-455 is a laminate of aluminum

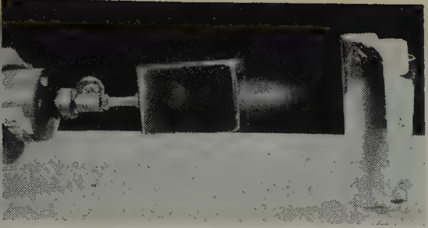
Specifying LAMINATED PLASTICS...as sheet,



TAYLOR FIBRE CO. BELONGS IN YOUR SPECIFICATIONS

Taylor has the products... offers more than 50 grades of industrial laminated plastics . . . including paper, cotton cloth, nylon, asbestos, glass cloth, or other base material impregnated with phenolic, melamine, silicone or epoxy resins and formed into sheets, rods and tubes under heat and pressure. Also a number of composite materials, including copper-clad laminated plastics, vulcanized fibre and laminated plastics, rubber and laminated plastics, asbestos and laminated plastics, and aluminum and laminated plastics.

Use this Taylor Selection Guide to make selections of the Taylor laminated plastics that will fit your requirements.



foil and glass cloth with a silicone adhesive. This combination enables the tape to withstand extremely high radiant heat temperatures. Photo shows PD-455 protecting a tumbler filled with ice cubes from the heat of a propane blowtorch. In tests, PD-455 has also shown good resistance to abrasion and chemicals and excellent resistance to aging. Industrial Div., Mystik Adhesive Products Inc., 2635 N. Kildare Ave., Chicago 39.

Print No. Ins. 149 on Reader Service Card

Fluorocarbon Mold Release In Large Aerosol Cans

An easy-to-apply reinforced fluorocarbon slip and anti-stick agent is now being offered in a new king-size 16-oz aerosol spray can. The "Rulon" spray reportedly provides a low-friction, dry surface which is chemically inert, insoluble, and thermally stable to 500°F. Coefficient of friction as low as .07 is said to eliminate "stick-slip" at low speeds. One major use expected is as a mold release in plastic and epoxy molding work. It is also suitable for use as a lubricant and as an anti-stick agent. Price is \$3.50 per 16-oz can, or \$35 per 12-can case. Dixon Corp., Bristol. R.I.

Print No. Ins. 150 on Reader Service Card

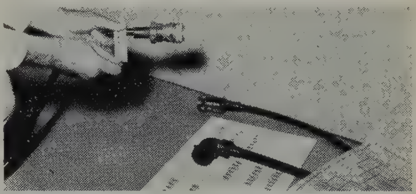
Slow Drying, Synthetic Rubber Adhesive

A slow drying, synthetic rubber adhesive compound for a wide variety of industrial applications, Adhesive No. 1, offers excellent immediate bond with an open time of up to 30 minutes. The clear adhesive may be used in a temperature range of —20°F to 300°F for lightweight materials. Excellent resistance to water and high humidity and a tight bond that resists moisture and vapor transmission are claimed. Arno Adhesive Tapes Inc., 4170 Ohio St., Michigan City, Ind.

Print No. Ins. 151 on Reader Service Card

Cable System Markers on Assembly Coded Cards

A new system of identifying and coding control system interconnection cables, called Identitape, is said to reduce system installation time and eliminate guess-work from cable and connector identification at the time of assembly. Work-oriented cards (based on customer's system diagram or cable routing list) contain coded identification and reference designation pressure-sensitive tapes, keyed to an interconnection drawing. The cards of specifically-marked individual tapes also can be arranged to follow specified equipment installation procedures based on order of assembly. The markers are removed easily from the assembly cards which are designed to withstand work-bench and field handling. Identitapes are available in a range of standard mate-



---

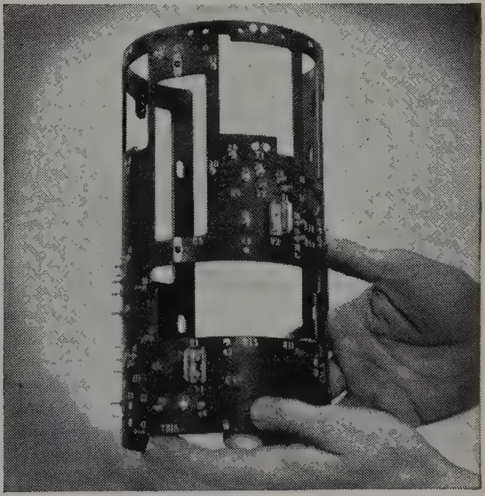
rod, tube or fabricated parts?

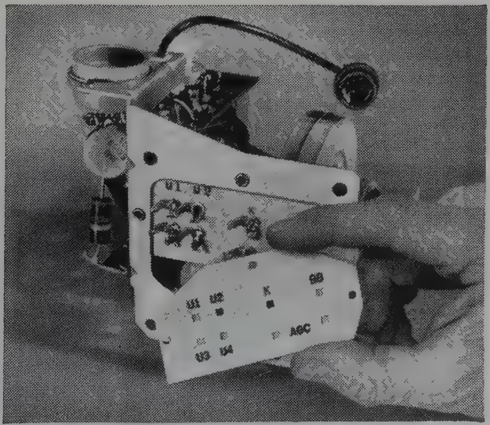
Taylor has the facilities. Its Norristown, Pa., plant, comprising some 300,000 sq. ft., produces both laminated plastics and vulcanized fibre . . . is one of the most completely integrated in the industry . . . even makes its own paper and a large percentage of its own resins. The La Verne, Calif., plant, with over 45,000 sq. ft. of floor space, specializes in the manufacture of laminated plastics for the convenience of West Coast customers. And both plants can fabricate parts from any Taylor materials to specifications, economically.

Taylor laminates offer many advantages over metals. They have a higher strength-to-weight ratio, are corrosion resistant, and can be fabricated more easily. This Taylor Selection Guide will help you evaluate the different grades available. Write for your copy today. Taylor Fibre Co., Norristown 51, Pa.

Taylor
LAMINATED PLASTICS VULCANIZED FIBRE

For applications requiring high strength retention at elevated temperatures, Taylor Grade GEC—an epoxy resin, glass fabric base material.

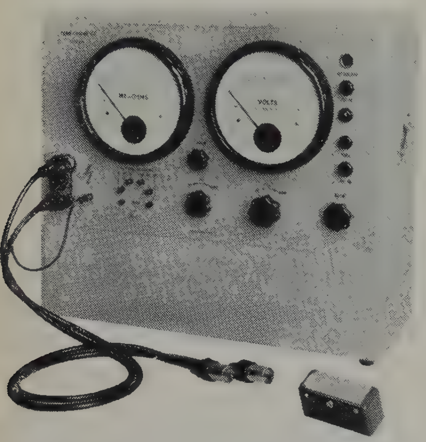




For high-temperature electrical applications and high-frequency radio equipment, Taylor Grade GSC—a silicone resin, glass fabric base material. Has high heat resistance, excellent electrical properties, and high arc resistance. Will not support combustion.

Print Ins. 45 on Reader Service Card

INSULATION MEASUREMENTS TO 5000 T ohms



and to 1000 Volts

TERAOHMMETERS

Designed for high accuracy resistance measurements, these Richard Jahre instruments cover the range 2 Megohms to 5000 Teraohms (5×10^{15} ohms) at potentials up to 1000 volts. A single electrometer tube insures maximum stability; leakage is eliminated by guard-ring technique; and accuracy is exceptionally high, due to the use of two large hand-calibrated meters for the measurement of test voltage and insulation resistance.

APPLICATIONS

Testing:
- Insulation of components, capacitors, transformers, cables, wires, etc.
- Insulating materials such as plastics, glass, ceramics, oils and varnishes.
- Purity of liquids

Determining:
- Voltage coefficient of materials and components.
- Temperature coefficients.
- Surface conditions.
- Leakage resistance of capacitors.
- Surface resistance of printed circuits.
- Moisture content of insulating materials.

Special sample holders are available for measuring the insulation resistance, dielectric constant, and dissipation factor of materials in sheet form, as liquids, or as wire insulation.

WRITE FOR ADDITIONAL INFORMATION

ROHDE & SCHWARZ
111 Lexington Ave., Passaic, N. J.
PRescott 3-8010

Print Ins. 46 on Reader Service Card

rials and colors, as well as "shrink-on" type. Nearly all industrial and military specifications are met, including Mil-I-7798 and AMS 3652 ("Teflon"). Literature and sample available. Manger Electric Co. Inc., Miller St., Stamford, Conn.

Print No. Ins. 152 on Reader Service Card

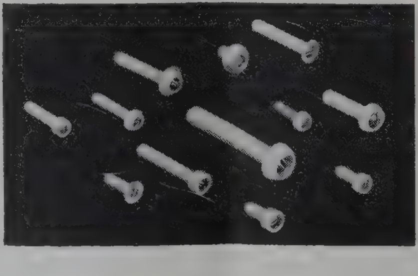
Screw-Type Terminal Wiring Connector Block

New screw-type terminal connector for printed circuits, type 520, is said to greatly simplify connections between external wiring and printed circuit boards. Multiple connections are provided by a single block regardless of how crowded printed wiring leads may be spaced. Blocks have terminal screws for ease in making external connections and can be supplied with from 2 to 24 terminals since they are cut to size. One-piece construction, deep-soldered in place and with wires fastened beneath the screw heads, is said to enable it to stand up better under the usual vibration tests than ordinary connections with two-piece construction. Kulka Electric Corp., subsidiary of Kulka Electronics Corp., 633-643 S. Fulton Ave., Mt. Vernon, N.Y.

Print No. Ins. 153 on Reader Service Card

Nylon-Steel Screws in Small Lots

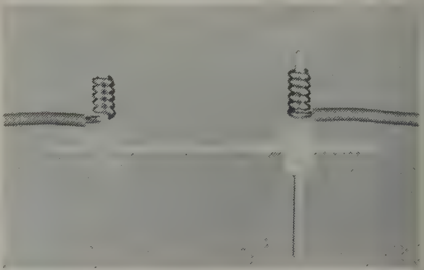
Composite plastic-metal screws may be obtained in small lots (as few as 10 of a size) for research and development, experimental, prototype, repair, and general laboratory and factory use. Packaged in units of 10 and 100 for easy handling and storing, the fasteners are also available in bulk for production requirements. These screws consist of natural colored nylon outer threaded screw with a cadmium-plated hardened steel core which is completely insulated. They are used in higher stress applications since they have up to 2½ times greater torque and shear strength than ordinary nylon screws, with ability to withstand shock loading and vibration. Self-sealing and corrosion resistant, they are said to be ideal for use with commercial liquids and gases. Machine Parts Supply Co., 13 East 37th St., New York 16.



Print No. Ins. 154 on Reader Service Card

'Teflon' Insulated Wire Wrap Connections

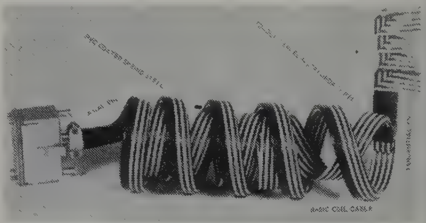
Wire wrap connections may now be made utilizing "Press-Fit" Teflon (Part No. FT-WJ-100) feed-through terminal. The FT-WJ-100 is rectangular in shape, with truncated circular ends. The chassis is prepared with a punch, forming a truncated circular or rectangular shape with beveled entrance. When pressed in and properly seated the terminal reportedly provides extremely high torque. Several round Teflon bodies with wire wrap terminal studs are also available. Sealectro Corp., 610 Fayette Ave., Mamaroneck, N.Y.



Print No. Ins. 155 on Reader Service Card

Extensible Cable with High Retractive Power

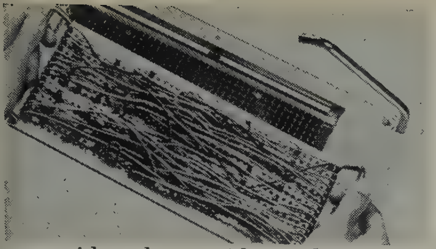
New extensible cable consists of two multi-conductor, helically wound cables, one wound inside the other and spiralling in opposite direction. This is said to result in a flexible assembly with exceptional power of retraction and large numbers of conductors with zero torque on the terminations. Spectra-Strip Wire & Cable Corp., P. O. Box 415, Garden Grove, Calif.



Print No. Ins. 156 on Reader Service Card

Pre-Programming Patchboards for Flexible Program Control

New pre-programming patchboards



are said to have wide application in any situation where flexible program control is required, such as in digital and analog computers, data processing equipment, test and control equipment, and automation systems. A wide range of sizes is now available including 200, 300, 450, 600, and multiples of 600 contacts. Special sizes can also be made to order. The boards are designed so that a simple engaging lever which is operated with one hand engages the pre-programmed panel with the rear frame assembly. They may be mounted either vertically or horizontally. A full compliment of single and multiple conductor self contacting type patch-cords is available. Special connectors can also be provided. Vector Electronic Co., 1100 Flower St., Glendale 1, Calif.

Print No. Ins. 157 on Reader Service Card

Polycarbonate Extrusions for Electrical/Electronic Insulation

Transparent, extra-strong "Lexan" polycarbonate resin for printed circuit boards, insulators, switchgear, and electromechanical devices is now nationally available in extended sheet and rod shapes. Features claimed include outstanding heat stability, impact strength, creep resistance, and dielectric properties. Its transparency makes it suitable for insulated, see-throughable electromechanical devices such as electric motors, display models, and prototypes. Its transparency also is of interest to manufacturers of printed circuit boards where improved methods of visual inspection have been sought. Lexan may be stamped, drawn, punched, and machined with conventional metalworking tools. The shapes are also expected to find wide acceptance for other applications, such as structural housings, coil forms, and electric and electronic insulators. Cadillac Plastic & Chemical Co., 15111 Second Ave., Detroit 3, Mich.

Print No. Ins. 158 on Reader Service Card

TEFLON*
HEADQUARTERS U.S.A.

SHEETS • RODS • TUBES • TAPES • HOSE
BONDABLE TEFLON • MACHINED PARTS • SPECIALTIES

One call does it all. Ask the man from R/M for *anything* you need in "Teflon"—standard shapes to finished parts. He can satisfy your requirements fast and efficiently.

By any measurement—research, complete line, experience, technical data, capacity, quality control, delivery and reputation—R/M should be your *first source* for "Teflon" products.

R/M "Teflon" Headquarters has grown to its present stature through outstanding dependability in its *own* production and delivery and in the performance of finished products.

Contact your nearest R/M district office listed below . . . or write for a copy of the latest catalog featuring R/M "Teflon" products.

*Registered TM for Du Pont fluorocarbon resins

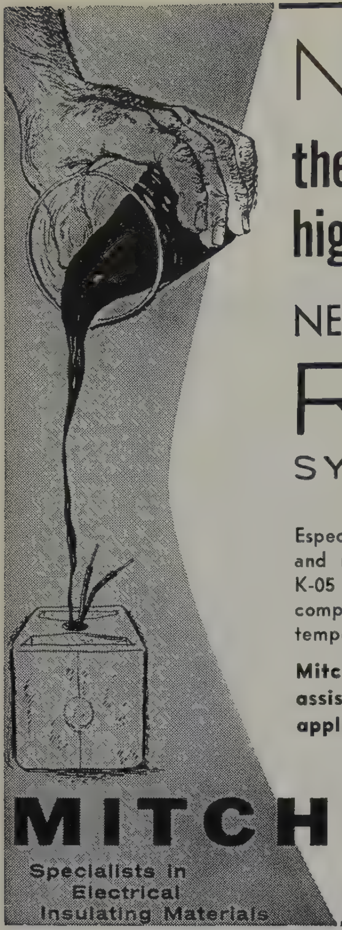
R/M

PLASTIC PRODUCTS DIVISION
RAYBESTOS-MANHATTAN, INC.
Manheim, Pa.

BIRMINGHAM 1 • CHICAGO 31 • CLEVELAND 16 • DALLAS 26 • DENVER 16 • DETROIT 2
HOUSTON 1 • LOS ANGELES 58 • MINNEAPOLIS 16 • NEW ORLEANS 17 • PASSAIC • PHILADELPHIA 3
PITTSBURGH 22 • SOUTH SAN FRANCISCO 5 • SEATTLE 4 • PETERBOROUGH, ONTARIO, CANADA

SPECIALISTS IN ASBESTOS, RUBBER, ENGINEERED PLASTICS, SINTERED METAL

Print Ins. 47 on Reader Service Card



NOW
thermal shock resistant high temperature epoxy

NEW RANDAC SYSTEM K-05

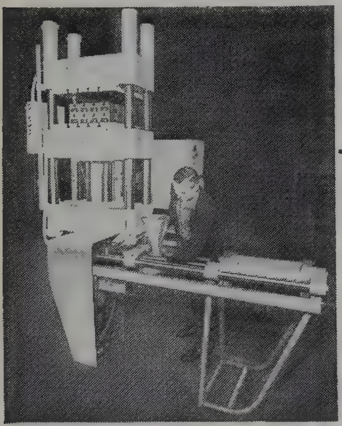
Especially recommended for its good electrical properties and mechanical strength at high temperatures. Randac K-05 is an embedding type resin designed for electronic components which must endure extremes of high and low temperature. (MIL-I-16923C, Type D).

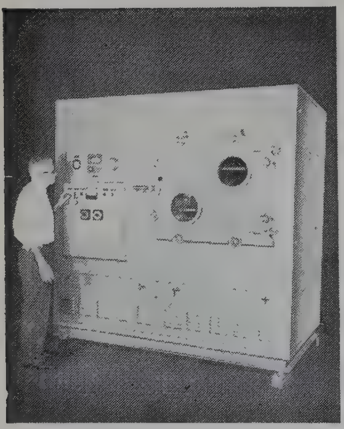
Mitchell-Rand engineers are available for technical assistance, consultation on epoxy materials and application problems.

MITCHELL-RAND
MANUFACTURING CORP.
51 Murray St., New York 7 • COrtlandt 7-9264

Specialists in Electrical Insulating Materials

Print Ins. 48 on Reader Service Card





GET THE HULL STORY

FOR YOUR LABORATORY OR PRODUCTION EQUIPMENT NEEDS, AND FOR APPLICATION ENGINEERING ASSISTANCE IN THE FOLLOWING BROAD AREAS:

- Compression and Transfer Molding
- Vacuum Impregnation and Potting
- Encapsulation
- Vacuum Metallizing
- Relay Drying and Filling
- Liquid Resin Metering, Mixing, Dispensing
- Vacuum Casting
- Vacuum Heat Treating
- Freeze Drying

UP-TO-DATE SYSTEMS — BOTH STANDARD & CUSTOM

HULL CORPORATION
Hatboro, Pennsylvania

Export Division: 1505 Race St., Philadelphia 2, Penna.

Print Ins. 49 on Reader Service Card

Synthetic Rubber for A-C Connectors in Mine

High voltage connectors insulated with "Hypalon" synthetic rubber are being used in the electrical system of one of the first coal mines in the United States to use alternating current throughout the installation.

The mine, operated for the Southern Electric Generating Co., produces bituminous coal for a steam-powered electric generating plant. Alternating current was specified for the installation to gain economies both in initial installation and in operations and maintenance.

However, the higher voltages used in alternating current installations underground require exceptionally high standards in equipment reliability. While adequate cable, switchgear, transformers, and safety controls were readily available, high voltage connectors capable of meeting mining requirements posed a major problem.

The rugged requirements were met by a relatively new elastomer which is noted for resistance to ozone, corona, weathering, and abrasion. The result (developed by Electrical Products Div., Joy Manufacturing Co., St. Louis, Mo.) was a rugged connector permanently vulcanized to the cable jacket, rated for 7,500 volts. The body material, Hypalon, is a chlorosulfonated polyethylene developed by Du Pont.

Work Force Changes

At the turn of the century in the United States, only seven percent of the total manufacturing work force was in the non-production category—scientists, engineers, and highly trained technicians—while today the percentage is 24 percent. The major portion of this gain was made in the past decade.

Silicone Rubber After 9000° F

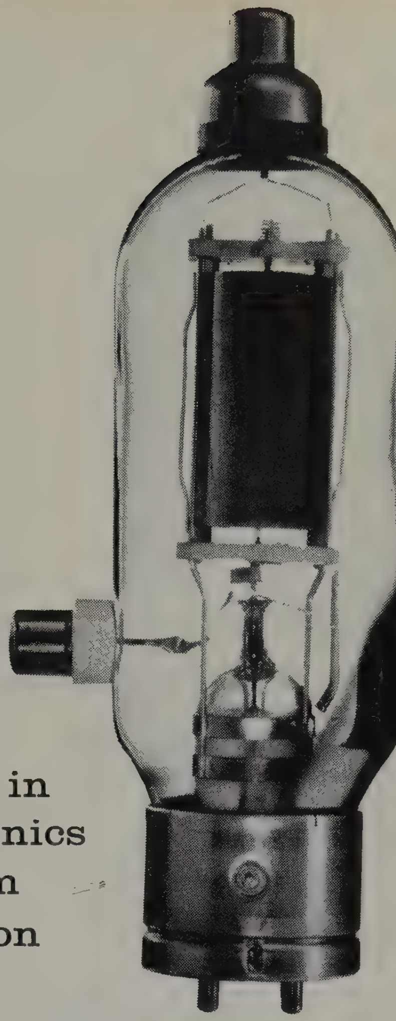
At a recent news conference, the Silicone Products Department of General Electric reported the results of testing of silicones for missiles and space vehicles which suggest the use of silicones for a wide variety of space applications. Silicone fluids, greases, resins, rubbers, and combinations for electrical insulation, which have been previously reported on in *Insulation*, served as one of the main areas of discussion. In addition, G-E showed samples (photo) of silicone rubber materials that had successfully withstood temperatures up to 9000°F produced in an electric arc supersonic wind tunnel. The half-inch thick sample was exposed for six minutes which caused a hard carbonaceous crust to form on the surface, leaving 70 percent of the rubber intact.

Thermosetting Plastics Extrusion

A process which has been used in Europe for some years, and now being developed in the United States, is being used by York Industrial Plastics Inc., York, Pa., to produce phenolic and other thermosetting plastic extrusions. Rods, tubing, and complex cross-sectional shapes reportedly can be produced. Physical and electrical properties are stated to be substantially identical with those of items conventionally molded of the same materials. The cost of phenolic extrusions is claimed to vary from 50 to 75 percent that of equivalent items fabricated by laminating.

PTFE Extruded Sheets

"Teflon" polytetrafluoroethylene in extruded sheet form is now being produced by Tri-Point Industries Inc., Albertson, N. Y., in continuous lengths. Greater density and other desirable characteristics are claimed for the extruded material in contrast to sheets made by pressure formation. Thicknesses from ¼ to 1-inch are available. Widths to 6 inches can presently be supplied and it is anticipated that widths to 24 inches will be available in the future.



Ideas in Electronics from Norton

The electronics industry became a giant before it became a baby.

This outstanding growth has been largely due to the development of new materials — *refractory* materials with a great range of electrical properties. The prime source of these *idea refractories* is Norton Company.

For example, refractory fused alumina has high constant resistivity, to assure minimum leakage between elements in TV, radio and radar tubes. The same material is a recent innovation for transistor potting. Norton silicon carbide is an essential component in lightning arrestors and other non-linear resistors because of its variable voltage-current relationship. Silicon carbide is also finding new uses in microwave absorption, and as single crystals in high temperature rectifiers and transistors.

Fused magnesium oxide, used in most heating elements for electric ranges, has gained acceptance in such areas as advanced thermocouple design and infrared transmission.

Norton offers a wide choice of super-refined refractories, including oxides, borides, nitrides and carbides, and is ready to work with you in engineering materials to meet your needs. But above all, Norton offers ideas in every field in which refractory materials play a part.

Write NORTON COMPANY, Refractories Division, 588 New Bond Street, Worcester, Massachusetts.

NORTON

REFRACTORIES

Crystallizing ideas into products

Print Ins. 51 on Reader Service Card

New Instruments and Equipment

For further information on these products print the item number on the Reader Service Inquiry Card on the back cover. Fill out and mail the card —no postage is required. Insulation *will immediately forward your inquiry to the manufacturers concerned so that they can send you more information promptly.*

◆

Laboratory Bandsaw for Contour Cutting of Hard Materials

A new precision laboratory bandsaw has been developed for wet or dry cutting of ceramics, technical glass, glass bonded mica, melamines, beryllium oxide, and other extra-hard materials. Specifically designed for diamond-coated bandsaw blades, it also accepts metal cutting blades. The unit is equipped with all rubber-tired guide wheels, permitting all contour cutting requirements to be met. It has 14″ wheels, 14″ throat, and variable speed drive with 0-1725 rpm range. With either ¼″ or ⅜″ blade, price is $650. Diachrome Inc., 612 W. Elk Ave., Glendale 4, Calif.

Print No. Ins. 201 on Reader Service Card

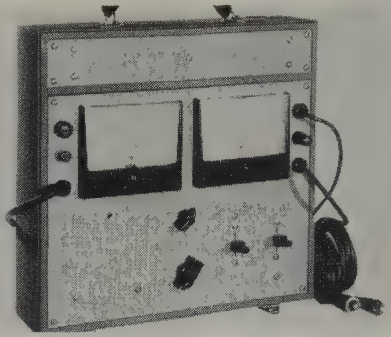
D-C Corona Tester with High Altitude Vacuum Chamber

A new corona test set with 20 kv corona-free d-c high voltage supply, corona pickup filter network, and corona detector, the model 5435 D-C, detects corona discharge and displays the voltage pattern on a built-in oscilloscope having special characteristics. A vacuum bell-jar and table mounted on top of the cabinet allow simulated high altitude testing of insulating materials, cables, components, and assemblies. The corona-free high voltage supply is continuously variable from zero to 20 kv. Output metering ranges of 0-5000 and 0-20,000 v, and 0-50, 0-500 and 0-5000 microamperes leakage current are provided. Associated Research Inc., 3777 W. Belmont Ave., Chicago 18.

Print No. Ins. 202 on Reader Service Card

Insulation Testing Megohmmeter Adjustable from 0 to 2500 V, D-C

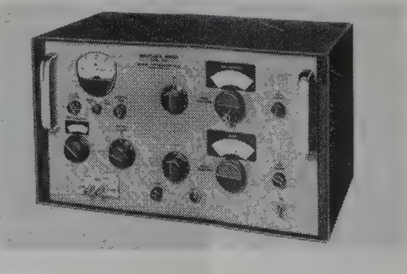
A new instrument for measurement of insulation resistance has a d-c test potential adjustable from 0 to 2500 v. Model 2955 "Vibrotest" is designed for dielectric absorption tests and plotting of insulation resistance at any selected voltages. An electronic power supply, operating from self-contained, lightweight batteries, provides the d-c high voltage test potential. Separate 4½″ long scale meters indicate test voltage and insulation resistance over the range of 100,000 ohms to 50,000 megohms. Associated Research Inc., 3777 W. Belmont Ave., Chicago 18.



Print No. Ins. 203 on Reader Service Card

Inductance Bridge

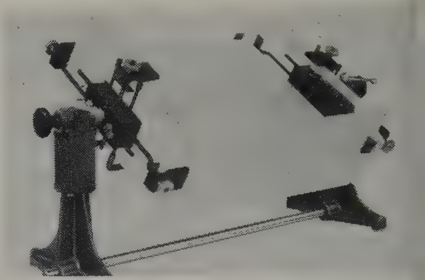
A new inductance bridge is designed for measurements in the audio frequency ranges between 0.4 and 20 kc. The instrument is a calibrated variable frequency oscillator coupled to a modified Maxwell bridge and includes a self-contained tunable null detector which provides discrimination against unwanted distortion often generated in components under test. Featured is the direct reading calibration of both the inductance and resistance dials; 850″ of calibrated dial provides resolution to .01%. Other specifications include: inductance range, .02 microhenries to 11 henries; resistance range, .002 ohms to 110 K ohms; accuracy in the order of 0.25%. Excellent stability and convenient operating features reportedly make the instrument ideally suited for inductance matching, temperature coefficient, and other laboratory or production applications. Boonton Electronics Corp., Morris Plains, N.J.



Print No. Ins. 204 on Reader Service Card

Chassis Fixture

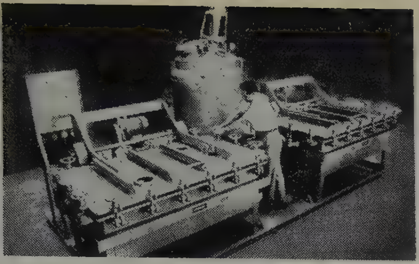
Designated "TD Model A," new holding device rotates, positions, and transports electronic chassis for assembly, test, and service. Special features include adjustable spindle height, 8 point fast action clamping, nylon glides, and adaptability to hold a wide range of chassis sizes. Rubber covered clamps and bumpers protect the chassis. Brochure available. Technical Devices Co., 11242 Playa Court, Culver City, Cal.



Print No. Ins. 205 on Reader Service Card

Vacuum Impregnating System For Transformers, Other Equipment

Better electrical transformers and other electrical equipment, with improved dielectric properties, are said to be produced in a new twin-chamber vacuum impregnation system. The system will impregnate transformer cores and windings with resins and varnishes which increase heat dissipation to permit cooler operating units. Complete "package" consists of two impregnating chambers, the storage tank, two vacuum pumps, and the control panel mounted together on a common baseplate, 8 ft by 18 ft, all piped and wired, ready for almost immediate use upon delivery. Impregnating chambers are 18″ deep, 72″ long, and 36″ front-to-back. The close-fitting covers, hinged along the rear

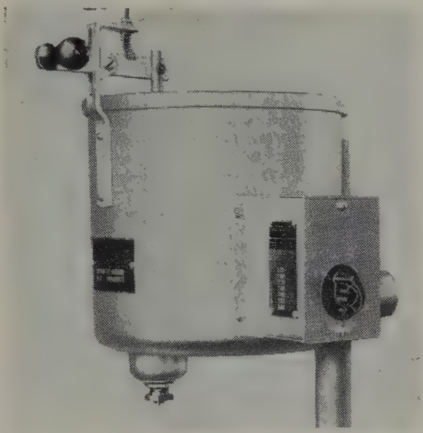


edges, are lifted by hydraulic cylinders. The chambers are designed to withstand an operating pressure of 15 psig, and full vacuum. The 200-gallon impregnant-reservoir is fitted with a motor-driven agitator. The tank is water-jacketed and cooling water is circulated through the jacket to keep the temperature of the impregnant from rising above 70°F. The chambers are evacuated by a single model 212-H 140 cfm "Microvac" vacuum pump, which is reported to have ample capacity to handle both chambers. The central control panel (the back of which can be seen at the left in the photograph) provides push-button operation of all motors and valves in the evacuation and flooding systems from a single point. F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.

Print No. Ins. 206 on Reader Service Card

Melting Equipment for Removing Insulation, Soldering

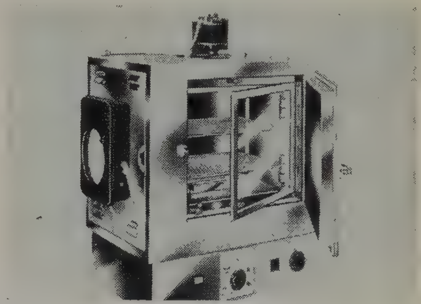
Standard and custom solder melting units are available in various sizes and shapes for a variety of applications, including production tinning for electrical components, removal of resin-based insulation, as well as providing a source of molten solder for laboratory or production operations. Rectangular shaped units are suited for dipping operations in printed circuitry fabrication. All units are equipped with a blanket-type heating element which is said to distribute heat evenly at minimum watt density to bottom and sidewalls. Available in either single-heat or three-heat (high, medium, low) and larger sizes with automatic thermostatic control, the solder melting units operate on voltages of 115, 208, 230, single phase, 50 or 60 cycle. Bulletin S1 available. Sta-Warm Electric Co., Ravenna, Ohio.



Print No. Ins. 207 on Reader Service Card

Batch Ovens for Electronics Industry

Infinitely proportional, stable, straight-line control of temperature (to 600°F) without cycling action is said to be built into industrial batch



Armature Twines, Wedges
Bi-Seal Tapes
Coil Winding Machines
Cotton Tapes and Webbings
Cotton Sleevings
Commutators
Cuffed Insulating Papers
Extruded Plastic Tubings
Fiberglas Tapes, Cords and Sleevings
Friction and Rubber Tapes
Insulating Varnishes and Compounds
Low-Pressure Laminates
Magnet Wire
Mica—Built-up and Raw
Motor Enamels
Pressure Sensitive Tapes
Safe-T-Seal
Silicone Rubber Fiberglas Tubings
Silicone Wedges
Silicone Varnish and Grease
Teflon Tape
Undercutting Machines and Saws
Varnished Sleevings and Tubings—
Cotton, fiberglas and rayon
Varnished Cambric, Paper and Tapes
Vinyl Fiberglas Tubings and Sleevings
Vinyl Tape
Wire Brushes

all your insulation needs

centrally ELECTRICAL INSULATION located for quick service

J. J. Glenn and Company

605 West Washington Blvd., Chicago 6, Ill.
STate 2-9669

135 Westbrook Road, Dayton, O.
CRestview 5-3354

7915 N. Boyd Way, Milwaukee, Wis.
FLagstone 2-7262

You'll Want the Handy New Glenn Reference Folder for Your File—Write Today!

Print Ins. 52 on Reader Service Card

DO YOU AVOID PLASTIC INJECTION MOLDING because you think it's too complicated, expensive?

It is easier than you think with a MINI-JECTOR®! No need to invest heavily in costly machinery, expensive tooling, or skilled personnel. Hundreds of leading companies have found MINI-JECTORS the low-cost answer to making their own precision plastic items and saved thousands of dollars. The machine: MINI-JECTOR (starts under $1,000); mold blanks low as $29.50; no previous experience necessary to operate. Molds perfect parts, including those involving inserts or loose cores, in all thermoplastics *including Nylon* (⅛ oz. to 2 oz.). New catalog shows how simple plastic injection molding can be with the MINI-JECTOR. Shows many models to fit your special needs . . . *at big savings.* Write today.

NEWBURY INDUSTRIES, INC.
Box 98, Newbury, Ohio

MINI-JECTOR

NEWBURY INDUSTRIES, INC.
Box 98, Newbury, Ohio

For convenience clip coupon to your letterhead and mail

Please send me your new free catalog.

Name__________

Company__________

Address__________

City__________ State__________

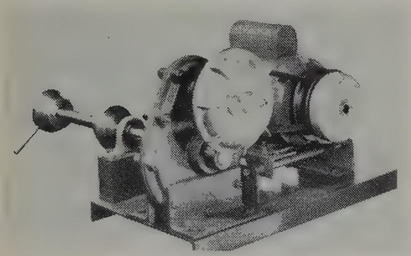
Print Ins. 53 on Reader Service Card

ovens for time/test procedures in the electronics industry, plus aging, curing, drying, tempering, coil and armature baking, pre-heating plastics, core baking, and transformer tests. Control is derived from a saturable reactor system without contacts, amplifiers, switches, moving parts, or auxiliary mechanisms that wear, burn, and/or arc. Blue M Electric Co., 138th and Chatham St., Blue Island, Ill.

Print No. Ins. 208 on Reader Service Card

Low Cost Reel Winders and Drives

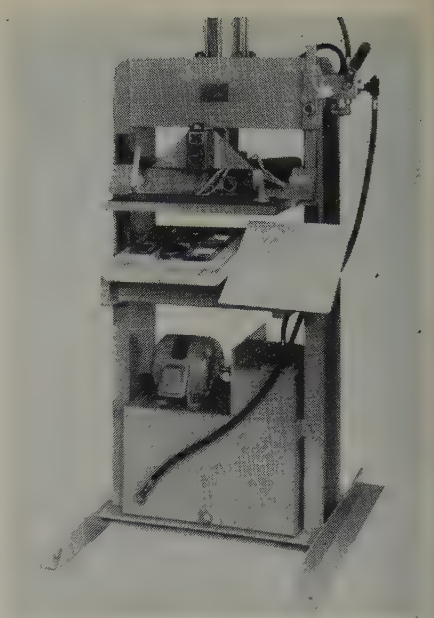
A new line of "Reel-Wynders" and winder drives has controlled tension for winding such materials as foil, plastics, paper, textiles, wire, cable, film and filaments, metal, tape tubing, laminations, extrusions, and for any other center winding operations. Five standard sizes available provide winding speeds from 3500 rpm through 3.5 rpm. Prices from $250 include ball-bearing a-c motor. Shipped assembled, less starter, ready for operation. Reel-Wynders can be adapted to both existing and OEM equipment. Fluid Drive Engineering Co., 313 Hibbard Rd., Wilmette, Ill.



Print No. Ins. 209 on Reader Service Card

Heavy Duty Die-Cutting Machines

Two models of a new machine for die-cutting sheet materials feature 20- or 40-ton capacity. These units are said to be capable of smoothly slicing through sheets of plastic, rubber, fiber, leather, wood, and soft metal. Each offers a ram speed of 96″ per minute, giving six 8″ or twelve 4″ strokes per minute. Platens are removable, surface ground, and measure 24″ x 30″ x 1¼″ (20-ton model) or 1¾″ (40-ton model). The return of the platen may be set in increments of 1″ to give from 6″ to 13″ daylight, with 26″ horizontal clearance. Controlled heating for the top platen and a roller carriage to handle tooling are offered as optional extras. Compulsory two-hand operation assures operator safety. G. F. Goodman & Son, Dept. 17, 401 Richmond St., Philadelphia 25, Pa.

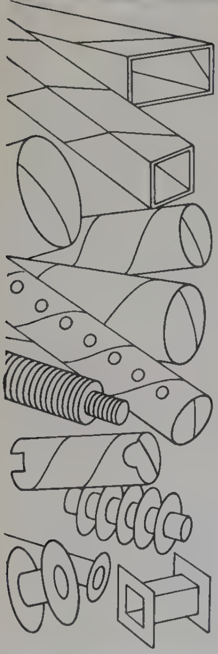


Print No. Ins. 210 on Reader Service Card

Automatic Micro-Modular Wire Cutter

New automatic wire cutter is designed for accurately cutting and handling wire, ribbon, and rod for welded or micro-modular circuit work. Model

High Quality Coil Forms For All Electrical Applications



SQUARE AND RECTANGULAR TUBES—Choice of any dielectric material or combinations. Any length, shape or size. Especially recommended for Class A, B and H temperature ranges.

ROUND TUBES—Any decimal size up to 8″. Fabricated from dielectric kraft, fish paper, acetate, DuPont Mylar, Johns-Manville Quinterra, fibre glass, other materials or combinations.

RESINITE PHENOLIC IMPREGNATED—Feature the highest resistivity of any resinated product. Furnished in any shape or size—plain, embossed or internally threaded, also in flyback transformer forms.

BOBBIN ASSEMBLIES—Fabricated to specification in any dielectric material for Class A, B and H temperature ranges. Supplied with metal, asbestos, plastic or fibre flanges.

Request catalog and prices. Ask about Precision's complete coil form service.

PRECISION PAPER TUBE CO.

2053 WEST CHARLESTON STREET • CHICAGO 47, ILL.

Print Ins. 54 on Reader Service Card

UNIQUE INSULATION PROPERTIES

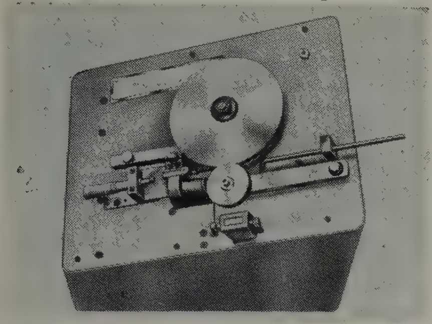
Only mica, a natural material, combines exceptional electrical insulation characteristics with extreme space-saving thinness and resistance to scorching temperatures and severe physical abuse. Huse-Liberty has the know-how necessary for making precision mica parts to meet your needs with no sacrifice of mica's outstanding characteristics. A few uses include supports, resistance cards, washers, transistor mountings, vacuum tube micas, microwave windows, tubes, and other critical electrical/electronic applications. Learn more about the advantages of natural mica now by using the reader service card number below.

THE HUSE-LIBERTY MICA COMPANY

Lynnfield St., Peabody, Mass., JEfferson 1-7100

Print Ins. 55 on Reader Service Card

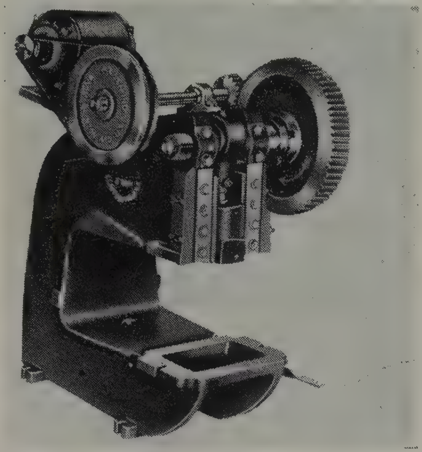
MMP-203 cutter is available in two versions—either electro-mechanical or electro-pneumatic. It is reported to produce production parts with an accuracy of better than ±.005″ at the rate of 1200 pieces/hr. MMP-203 will handle #40 wire or larger, bare or insulated, and ribbon as small as .003″ x .015″ can be handled with minor modifications of the feed jaws. Typical adjustable lengths are .250″ to 14.0″. Adjustments for lengths and wire sizes are said to be accomplished easily, and the unit can be set up in a few minutes. All functions, such as feed, cut-off, and clamp, can be individually controlled for single piece production or set-up purposes. Unit weighs approximately 60 lbs. Price is $845. Literature available. Dickinson & Associates, 334 North Central Ave., Glendale 3, Calif.



Print No. Ins. 211 on Reader Service Card

Back Geared Punch Presses

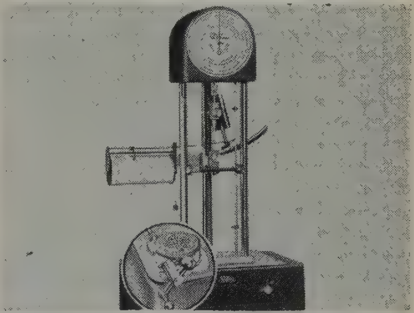
Back geared presses for many deep draw and forming operations and many types of punch press work requiring special feeding range in capacity from 2 tons through 25 tons. These presses give slow, powerful strokes, resulting in more advantageous applications of flywheel inertia for many operations and can easily be changed from repeat to non-repeat action. Strokes per minute or flywheel revolutions per minute can be reduced as desired without sacrificing loss of press tonnage capacity. Alva Allen Industries, 1001-15 N. Third St., Clinton, Mo.

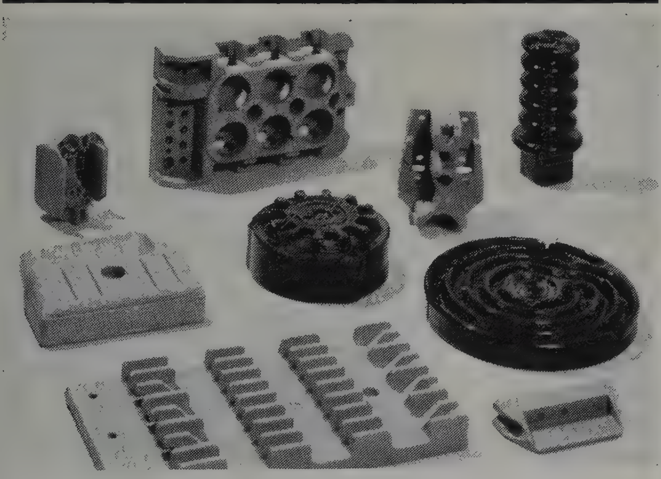


Print No. Ins. 212 on Reader Service Card

Speed Control for Low-Range Testers

New remote speed control permits greatly increased precision in presetting a low-range strength tester to ASTM and Federal specifications. A simple turn of the new 360° segmented dial permits an infinite variance of the traveling crosshead speed from 0″ through 20″ per minute. Beveled edge of the dial provides a



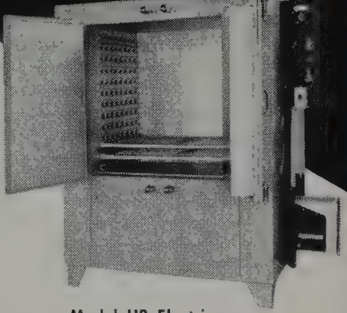


for the best in ceramics...

● If you have been looking for a supplier of electrical porcelain that produces consistent top quality parts order after order, we invite you to investigate STAR for all your needs. Here at STAR, we operate under rigid quality standards from basic raw materials to finished product. Close inspection by an experienced statistical quality control group helps you reduce assembly problems and resultant factory losses. Write today. We are eager to work with you.

The STAR Porcelain Company
34 MUIRHEAD AVENUE, TRENTON 9, N. J.

Print Ins. 56 on Reader Service Card



Precise engineering and construction result in

UNIFORM HEAT

throughout the work space

- High velocity recirculating blowers
- Greater heat input
- Adjustable louvres for balanced airflow
- Superior heat seals

All combine to provide *excellent temperature uniformity* in these rugged cabinet ovens.

Model HB Electric or Gas Cabinet Oven

30 Standard Models

- Work space from 4.6 to 72.3 cubic feet
- Temperature ranges from 100 to 1250° F.
- Electronic combustion devices insure safety for gas fired models
- Indicating control instrument
- Factory tested

Other ovens from $121.50 up, including a complete line of laboratory, bench, cabinet, walk-in, and custom-built units.

Write for literature to help you select the right oven for your application

Specialists in Heat Process Equipment

GRIEVE-HENDRY CO.
1334 N. Elston Ave., Chicago 22, Ill.

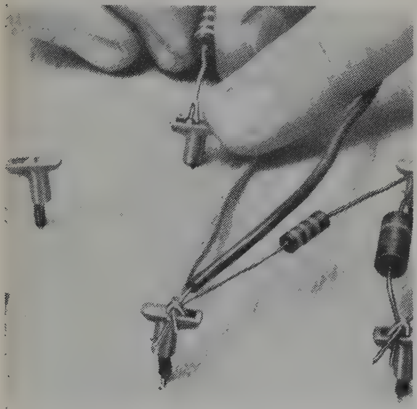
Print Ins. 57 on Reader Service Card

cross-hair register with the index line for fine positioning. Counterbalanced Balcrank handle reportedly gives the technician a sensitive, positive feel while setting. Top-of-cabinet location assures clear viewing and reading. Remote speed controls are now supplied for low-range testers in the following 5 ranges: 0-10 lbs, 0-25 lbs, 0-50 lbs, 0-100 lbs, and 0-300 lbs. A wide variety of gripping fixtures and accessories are available for testing materials for tensile, compression, transverse, and shear. W. C. Dillon & Co. Inc., 14620 Keswick St., Van Nuys, Calif.

Print No. Ins. 213 on Reader Service Card

Drive-In Clip for Wiring Boards

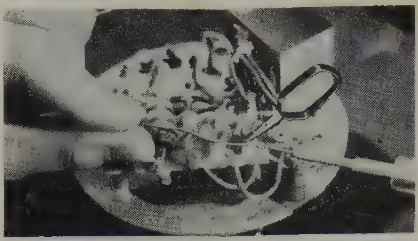
New E-Z Hook Nail Clip is especially designed to provide a quick, convenient terminal for breadboard layouts, demonstration boards, and experimental hookups built on plywood boards and similar material. It is also said to be ideal for use on harness boards. The positive clamping action of the E-Z Hook connector and the time saving "drive-in" design reportedly provide an ideal combination for use in making all kinds of harness cable assemblies. The stainless steel and nylon construction holds up to four wires and is easy to mount on boards with a hammer and simple driving tool. No drilling or counterboring is required. The resilient, shock-absorbing anchor also is claimed to prevent damage due to excessive strain and sudden jerks in assembly. E-Z Hook Test Products, 1536 Woodburn Ave., Covington, Ky.



Print No. Ins. 214 on Reader Service Card

Midget Heat Sink

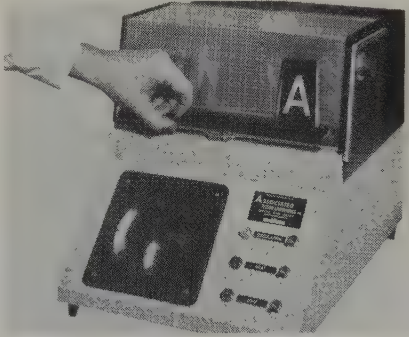
A small, lightweight heat sink is only 1¼″ long and has slim points to get into confined areas. These new heat sinks are made of "Berylco" 10 because of its high thermo-conductivity and good spring characteristics. The handles are covered with plastic to keep finger area cool and comfortable. To order, specify stock #51G. R. N. Hunter Sales Co., 9851 Alburtus Ave., Santa Fe Springs, Calif.



Print No. Ins. 215 on Reader Service Card

Low Cost, Small, High-Low Temperature Test Chamber

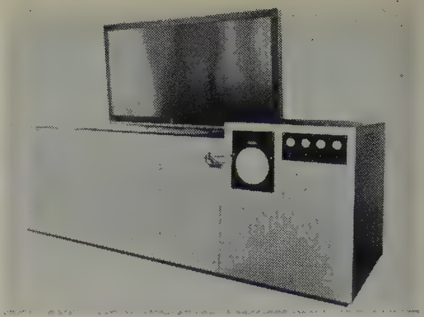
A small, high-low temperature test chamber, the Econ-O-Line Mark II (model ELH -0.5-LC), is designed to answer the requirements for a temperature test capability both in the research and development laboratory and on the production line. The chamber utilizes a rugged and durable indicating controller along with liquid CO_2 refrigeration. Other features include: internal working dimensions of 11″ x 12″ x 5″; a temperature range of —100°F to +350°F; a resistance element heater; an aluminum liner; and a fan with external blower motor for circulation. Price is $285. Associated Testing Laboratories Inc., Wayne, N.J.



Print No. Ins. 216 on Reader Service Card

Environmental Chamber For Use Down to —250°F

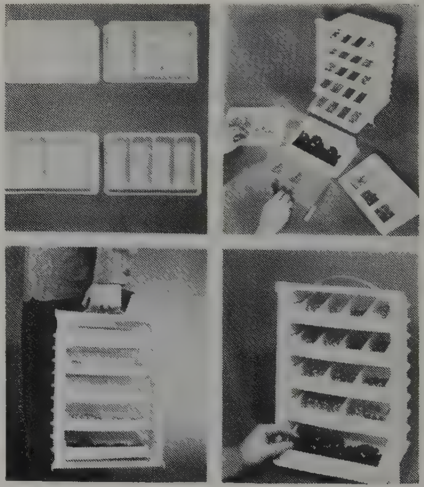
New environmental chamber with a mechanically refrigerated closed system is stated to reach —250°F (—156.66°C). Model WT-8-250 is designed to make possible many new applications for low temperature work in research, processing, and production. Webber Manufacturing Co. Inc., P. O. Box 217, Indianapolis 6, Ind.



Print No. Ins. 217 on Reader Service Card

Portable Storage Bin for Electronic Hardware

A new type bin system for storage of electronic hardware makes possible moving or storing of an entire assembly station without the usual time loss for set-up and knock-down, particularly for short-run jobs. The bins are designed to complement a carrying case for electronic components. Like the case, the bins are thermoformed of non-breakable "Grex" high density polyethylene, which is said to be resistant to corrosive chemicals, solvents, cleaning solutions, and temperature extremes. The bins are available in one, two, three, and four compartments (top left). They can be used individually or with the carrying case (top right). The case has a carrying handle and a clear front panel for dust protection during storage (bottom left). Carried in the cabinet, the bins in their various sizes can be used in any combination up to as many as 20 separate compartments in an area of 8″ x 12″ of assembly bench space (bottom right). Highland Products Inc., P. O. Box 91, Dover, N.J.



Print No. Ins. 218 on Reader Service Card

New Literature

All catalogs, bulletins, and other literature or sample cards described are available free of charge. To obtain your free copies, just print the item number on the Reader Service Card on the back cover. Fill out and mail the card—no postage is required. Insulation *immediately forwards your requests to the companies concerned so that the literature can be sent to you promptly.*

Insulation Conference Brochure

New brochure solicits exhibitors for the fourth Electrical Insulation Conference to be held February 19-22 in Washington, D.C. It discusses all conference activities, including technical sessions and special events. It gives exhibit hours, exhibitors' afternoon details, and booth size, locations, and fees. Lists of conference committee members and of those who exhibited last year are included. 8 pages. Electrical Insulation Conference, 155 East 44th St., New York 17.

Print No. Ins. 301 on Reader Service Card

Brochure on Cement Coated Epoxy Magnet Wire

New technical brochure describes a class B epoxy enameled magnet wire with an overcoat of a newly-developed epoxy-type cement. When subjected to the heating cycle, the cement surface softens just enough to form an extra-strong bond to the adjacent wires, providing coils which reportedly maintain their shape without ties or braces up to 200°C. Applications are expected in distribution transformers, pancake windings, solenoid coils, television yoke coils, and encapsulated coils. Anaconda Wire and Cable Co., EFL-P6, 25 Broadway, New York 4.

Print No. Ins. 302 on Reader Service Card

Brochure Describes Integrated Wire and Cable Services

New brochure describes and illustrates new integrated wire and cable manufacturing facility in Gardena, Calif. It describes engineering and sales services and gives complete information about the manufacturing capability of the plant which includes a complete line of military hook-up wires, a full range of UL appliance wires including all computer constructions and semi-rigid vinyl insulated wires, military airframe wires, vinyl jacketed cables with cores up to $1\frac{9}{16}''$ and finished diameters up to 2″, and unlimited range of sizes in cold process neoprene jacketed cables. 12 pages. Brand-Rex Div., American Enka Corp., 31 Sudbury Rd., Concord, Mass.

Print No. Ins. 303 on Reader Service Card

Technical Bulletin on New Nitrile Silicone Fluids

New technical bulletin S-21 describes recently introduced experimental nitrile silicone fluids. Presence of nitrile groups gives the fluids high polarity, resulting in such properties as solvent resistance, limited electrical conductivity and high dielectric constant. Tables and text show typical properties of available grades as well as some suggested uses. 4 pages. General Electric Co., Silicone Products Dept., Waterford, N.Y.

Print No. Ins. 304 on Reader Service Card

Bulletin on Heat Shrinkable Class B and C Plastic Tubings

New bulletin describes electrical and other characteristics of two types of heat shrinkable plastic tubings: Series PO, an irradiated, thermally stable class B material; and Series TE, a class C material modified from polytetrafluoroethylene. They are used to insulate connectors, components, and irregular shapes. A chart lists minimum expanded ID and recovered dimensions (maximum ID and wall thickness) for all sizes of each type of tubing. 4 pages. L. Frank Markel & Sons, P.O. Box 752, Norristown, Pa.

Print No. Ins. 305 on Reader Service Card

Brochure on 1000°F Wire and Cable

Brochure gives the results of tests

BIDDLE INSTRUMENTS

CORONA TEST EQUIPMENT

. . . for tests on electrical insulating materials, individual insulation structures and insulation of electrical equipment like cables, transformers, switchgear, rotating machinery, capacitors, bushings and communication apparatus . . . for measuring corona starting and extinction voltage, apparent corona charge, relative corona current. Your inquiries for special applications are invited.

WRITE FOR BULLETIN 66-IS

JAMES G. BIDDLE CO.
Electrical and Speed Measuring Instruments
1316 ARCH STREET, PHILADELPHIA 7, PA.

Print Ins. 58 on Reader Service Card

GROMMETS

ONE-PIECE NYLON

Simple Installation

● Snug fit—no rattle ● High static strength and retention characteristics ● Superior wear resistance without abrasion ● Excellent electrical properties ● Greatly simplify stocking. 4 basic lengths fit sheet gages from .025 to .250 ● Grommet is merely inserted through aperture. A simple tool flares protruding shank until induced hoop stresses flip shank back on itself. ● No heat needed in installation.

Write or phone for name of nearest representative.

WESTERN SKY INDUSTRIES

Dept. I • 21301 Cloud Way, Hayward, Calif.

Print Ins. 59 on Reader Service Card

on new "MGT" lead wire said to have an operating temperature of 1,000°F and to have outstanding flexibility and moisture resistance. Also included is a reference chart for high temperature wire and cable which gives the operating temperatures for various primary and jacket insulations on cables, coaxial cables, airframe wires, hook-up wires, and magnet wires. 4 pages. American Super-Temperature Wires Inc., West Canal St., Winooski, Vt.

Print No. Ins. 306 on Reader Service Card

Brochure Describes and Illustrates Plastic Extruders

New brochure describing and illustrating a complete line of plastic extruders gives complete specifications, including LE/D ratios available, length of center line, type of control panels available, selection of heaters, screws, and other pertinent details. 4 pages. Olympia Tool and Machine Co., 119-121 Delancy St., Newark 5, N.J.

Print No. Ins. 307 on Reader Service Card

Portable Electrical Testers Catalog

New catalog Cir. Z-54 lists a full line of portable electrical testing units, with complete data on models, accuracies, ranges, features, and prices. Among those listed are matched a-c and d-c industrial meters, a portable current transformer for use as an a-c multiplier, d-c portables especially suited for laboratory needs, and multipurpose industrial instruments including a power analyzer and an industrial circuit tester. Other units described include general purpose test instruments such as a-c clamp voltammeters, ohmmeters, and volt-ohm milliammeters, and combination portable/panel meters in a variety of a-c and d-c types. Another section describes light measuring instruments and relays. Rounding out the line covered are two electronic test items, a sensitive and rugged volt-ohm-milliammeter, and a precision transconductance type tube checker. 8 pages. Daystrom Inc., Weston Instruments Div., 614 Frelinghuysen Ave., Newark, N.J.

Print No. Ins. 308 on Reader Service Card

Test Data on Glass-Bonded Mica for High Frequency Uses

Literature details new information on high temperature glass-bonded mica as a high frequency insulator. The test data presented on "Mykroy" 750 and 1100, which conform to Mil-I-10A-L443 and Mil-I-10A-L442 respectively, reportedly establish the two grades as excellent low loss insulators at high frequencies. Electronic Mechanics Inc., 101 Clifton Blvd., Clifton, N.J.

Print No. Ins. 309 on Reader Service Card

Bulletin on Self-Bonding Rubber

Illustrated technical bulletin describes the first of a series of new self-bonding silicone rubber compounds. It discusses applications and describes the simple technique for obtaining superior primerless bonds to ferrous-containing metals. Also included are several charts and tables showing typical properties. 4 pages. Silicone Products Dept., General Electric Co., Waterford, N.Y.

Print No. Ins. 310 on Reader Service Card

Heat Sink Data Sheet And Hand Tool Catalog

An all-aluminum heat sink specially designed for soldering of fine wires is illustrated and described in a new literature sheet. Handicraft Tool catalog, an illustrated booklet describing a complete line of precision hand tools for industry, is also available. Handicraft Tools Inc., Div. of X-acto Inc., 48-41 Van Dam St., Long Island City 1, N.Y.

Print No. Ins. 311 on Reader Service Card

Catalog of Spray Cleaning Solvents and Methods

New catalog of spray-cleaning solvents and methods for cleaning small parts where microscopic cleanliness is demanded describes products and systems of use in cleaning contact points, soldered connections, and small electronic components such as semiconductors, potentiometers, capacitors, etc. Specifications and application data on bench and portable spray units and examples of custom designed systems for assembly line use are fully described. Also listed are performance characteristics of a spray clean solvent, which removes such contaminants as oil, grease, silicone lubricants, rosin flux, and lapping compounds. Cobehn Inc., 226 Passaic Ave., Caldwell, N.J.

Print No. Ins. 312 on Reader Service Card

Bulletin on Humidity Transducer

New bulletin discusses general specifications and characteristics of an electro-humidity transducer (an electric hygrometric circuit element which senses changes in relative humidity by changes in ohmic resistance). 4 pages. Phys-Chemical Research Corp., 40 East 12 St., New York 3.

Print No. Ins. 313 on Reader Service Card

Record Cards Forecast Failures of Motors, Generators, Other Equipment

A system for predicting failures of motors, generators, and other electrical equipment is provided with an insulation resistance record card. By measuring the insulation resistance of electrical equipment at regular intervals and entering the readings on this record card, a curve of the insulation deterioration is secured. A sudden drop in the curve gives advance warning of insulation failure. Associated Research Inc., 3777 W. Belmont Ave., Chicago 18.

Print No. Ins. 314 on Reader Service Card

Data Sheet on Insulating Wire Connectors

New data sheets list sizes and advantages of porcelain and "Bakelite" plastic insulated connectors for solid or stranded wires, or both. Sizes of a high voltage porcelain connector for wiring cold cathode and slimline fixtures are also given. Samples also provided. 2 pages. Holub Industries Inc., 413 DeKalb Ave., Sycamore, Ill.

Print No. Ins. 315 on Reader Service Card

Brochure on Machining Of Laminated Plastics

Techniques for machining laminated plastics are described in a new brochure. Illustrated design hints are also shown. Machining operations described include circular sawing, band sawing, turning and boring, threading, automatic screw machining, drilling, milling, gear cutting, punching, and machining of hard-grade laminates. Recommendations on tools to

be used, speeds, feeds, cooling and lubrication, and other important details on machining practices are given for each operation. Eleven different hints for designing with laminated plastics, each with a detailed drawing, are presented. 8 pages. Synthane Corp., Oaks, Pa.
Print No. Ins. 316 on Reader Service Card

Newsletter on Adhesives, Coatings, and Treatments

Newsletter reports on progress in surface chemistry, including adhesives for rubber, metal, and plastics; polyurethane coatings; and surface treatments. 2 pages. Chemfacts, Hughson Chemical Co., Div. of Lord Mfg. Co., Erie, Pa.
Print No. Ins. 317 on Reader Service Card

Bulletin on Tiny Component Sockets and Connector Assemblies

New bulletin provides technical data on "Tran-Grip" miniature and microminiature component sockets and connector assemblies. Operating principle, advantages, types, applications, and specifications are covered. 2 pages. Omega Precision Inc., 757 N. Coney Ave., Azusa, Calif.
Print No. Ins. 318 on Reader Service Card

List of 1239 Physical Testing Machines

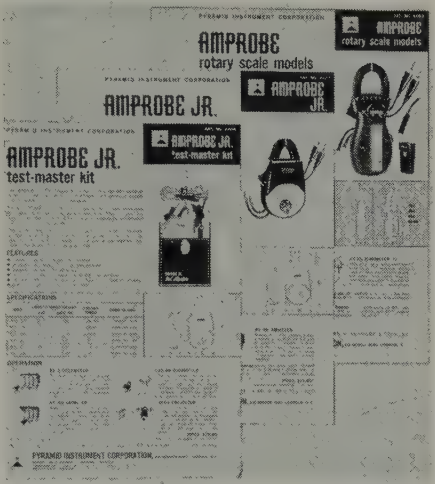
For those interested in research, development, or quality control, a new reference lists 1239 physical testing machines for all industries. The equipment has been compiled from world wide sources, and is the result of 42 years of cumulative effort. 8 pages. Testing Machines Inc., 72 Jericho Turnpike, Mineola, N.Y.
Print No. Ins. 319 on Reader Service Card

Manual of Facts on Subcontract Manufacturing

A new "Manual of Facts" on subcontract manufacturing services presents useful information on the "To Build or To Buy?" problem that frequently confronts industrial management. Included is a five-point program for reaching a decision on whether a specific component or assembly should be built in a company's own plant or if the services of an outside contract manufacturer should be employed. 16 pages. Paraplegics Manufacturing Co. Inc., 304 N. York Road, Bensenville, Ill.
Print No. Ins. 320 on Reader Service Card

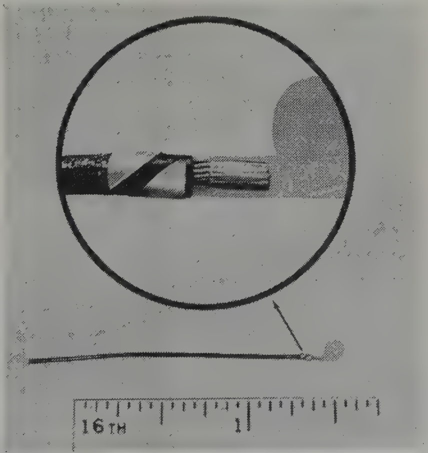
Test Instrument Data And Price Sheets

Three new data and price sheets list in complete detail the following instruments: "Amprobe" rotary scale models (RS-1, RS-2, RS-3, RS-300), cable tracer, testmaster kits, Deca-Tran, and energizer. Pyramid Instrument Corp., 630 Merrick Road, Lynbrook, N.Y.
Print No. Ins. 321 on Reader Service Card


AMPROBE
rotary scale models
AMPROBE JR.
AMPROBE JR.
test-master kit
PYRAMID INSTRUMENT CORPORATION

Bulletin on Metal Sheathed Thermocouples

New bulletin describes metal sheathed thermocouples consisting of up to six or more wires encased in hard-compacted, high-purity alumina oxide, magnesium oxide, or zirconium oxide and sheathed in metal to meet ISA calibration accuracy, and all MIL or AEC specs. Outstanding features and data on junctions, configurations, terminations, and sizes, etc., are given in catalog supplement #161-A. 4 pages. Harco Laboratories Inc., 77 Olive St., New Haven, Conn.
Print No. Ins. 322 on Reader Service Card



POSITION OPEN

ELECTRICAL INSULATION SALESMAN

Excellent opportunity for experienced man capable of maintaining and increasing established OEM territory for manufacturer and distributor of electrical insulation.

Sales Area — Greater Chicago and nearby Indiana and Illinois territory.

Age—30-38

Compensation Plan—Salary and incentive plan and expenses.

Education — Degree not necessary—E. E. or chemical background or equivalent technical sales experience.

Reply to:
Section E9A
Insulation
Box 270
Libertyville, Illinois

BIDDLE INSTRUMENTS

DIELECTRIC TEST EQUIPMENT

40 KV Model is a one-man portable set for maintenance d-c tests. Maximum safety built in. Simple operation. Reliable performance. You get excellent output voltage with facilities for voltage and leakage current measurements.

Also available: model for operation up to 100 KV and another for operation to 5 KV. Useful for development work to test d-c dielectric strength of insulating materials and adequacy of design of insulation in equipment; also in production tests for non-destructively detecting defects in electrical insulation.

Write for BULLETIN 22-IS.

B1006

BIDDLE

JAMES G. BIDDLE CO.
Electrical and Speed Measuring Equipment
1316 Arch Street, Philadelphia 7, Pa.

Print Ins. 60 on Reader Service Card

ELECTRICAL INSULATION

EUROPE and the BRITISH COMMONWEALTH

A British Company, with first-class modern plant in England and a live marketing organization covering Europe and the British Commonwealth, is open to handle or manufacture under license new materials in this field.

Details to:

Managing Director
Section No. E-9B
Insulation
Box 270
311 East Park Ave.
Libertyville, Illinois

PROCESS ENGINEER

This position calls for creative engineering and control of manufacturing processes in coated fiberglass sleeving production using silicone rubber, vinyl, acrylic and other insulation.

Background desired: a knowledge of the wire and cable or sleeving fields; experience with continuous coating processes; degree in Mechanical Engineering.

Future management opportunities excellent in rapidly growing company. The company is the outstanding pioneer in new and patented electrical insulated sleevings. Nationwide distribution. Concentration on Research and Development. Starting salary in five figures. Excellent benefits. Write and send personal history data.

BENTLEY-HARRIS
MANUFACTURING CO.
A SUBSIDIARY OF RAYCHEM CORPORATION
Dept. E-9C
CONSHOHOCKEN PENNSYLVANIA

Dates to Circle

Meeting and Convention Notices

Sept. 6-8 . . . Joint Nuclear Instrumentation Symposium, AIEE-IRE-ISA, North Carolina State College, Raleigh, N.C.

Sept. 6-8 . . . IRE, National Symposium on Space Electronics and Telemetry, Albuquerque, N.M.

Sept. 11-15 . . . 16th Annual Instrument Society of America Instrument-Automation Conference and Exhibition, Biltmore Hotel and Memorial Sports Arena, Los Angeles.

Sept. 12 . . . SPE, Plastics for Tooling, Retec sponsored by Central Indiana Section, Hotel Severin, Indianapolis, Ind.

Sept. 12-14 . . . EIA, Fall Conference, New York City.

Sept. 14-15 . . . Engineering Management Conference, AIEE and ASME, Hotel Roosevelt, New York City.

Sept. 21-22 . . . Industrial Electronics Conference, AIEE, IRE, and Instrument Society of America, Bradford Hotel, Boston, Mass.

Sept. 24-27 . . . AIEE-ASME, National Power Conference, St. Francis Hotel, San Francisco.

Sept. 24-29 . . . Illuminating Engineering Society, National Technical Conference, Chase Park Plaza Hotel, St. Louis, Mo.

Sept. 25-28 . . . American Welding Society, Fall Meeting, Adolphus Hotel, Dallas, Texas.

Oct. 1-5 . . . Electrochemical Society, Statler Hotel, Detroit, Mich.

Oct. 2-4 . . . IRE; Canadian Electronics Conference, Automotive Building, Exhibition Park, Toronto, Canada.

Oct. 5 . . . Plastic Foams, Retec sponsored by Buffalo Section, SPE, Niagara Falls, N.Y.

Oct. 9-11 . . . National Electronics Conference, sponsored by AIEE, IRE, Illinois Institute of Technology, Northwestern University, and the University of Illinois, International Amphitheatre, Chicago.

Oct. 10-12 . . . ASA, 12th National Conference on Standards, Rice Hotel, Houston, Texas.

Oct. 12-13 . . . SPI, 17th Annual New England Section Conference, Wentworth-by-the-Sea, Portsmouth, N.H.

Oct. 15-20 . . . AIEE, Fall General Meeting, Statler-Hilton Hotel, Detroit, Mich.

Oct. 23-25 . . . Conference on Electrical Insulation, National Academy of Sciences—National Research Council, Pocono Manor Inn, Pocono Manor, Pa.

Oct. 23-25 . . . IRE, East Coast Conference on Aerospace and Navigational Electronics, Lord Baltimore Hotel, Baltimore, Md.

Oct. 23-26 . . . The Wire Association, Annual Convention, French Lick-Sheraton Hotel, French Lick, Ind.

Oct. 25 . . . SPE, Plastics in Major Household Appliances, sponsored by Kentuckiana Section, Monogram Hall, Appliance Park, Louisville, Ky.

Oct. 26-28 . . . IRE, Electron Devices Meeting, Sheraton-Park Hotel, Washington, D.C.

Oct. 30-Nov. 1 . . . IRE, Radio Fall Meeting, Hotel Syracuse, Syracuse, N.Y.

Nov. 6 . . . AIEE, Third Western Technical Conference, Biltmore Hotel, Los Angeles, Calif.

Nov. 6-8 . . . 6th Annual Special Technical Conference on Nonlinear Magnetics, AIEE and IRE, Statler-Hilton Hotel, Los Angeles, Calif.

Nov. 7-9 . . . Eighth Industrial Electric Exposition, Electric League of Western Pennsylvania, Pittsburgh Room, Penn-Sheraton Hotel, Pittsburgh, Pa.

Nov. 13-16 . . . 7th Annual Conference on Magnetism and Magnetic Materials, AIEE and American Institute of Physics, Hotel Westward Ho, Phoenix, Ariz.

Nov. 14-16 . . . IRE, Northeast Electronics Research and Engineering Meeting, Boston, Mass.

Nov. 15-17 . . . Aerospace Electrical Society, Annual Display, Pan Pacific Auditorium, Los Angeles, Calif.

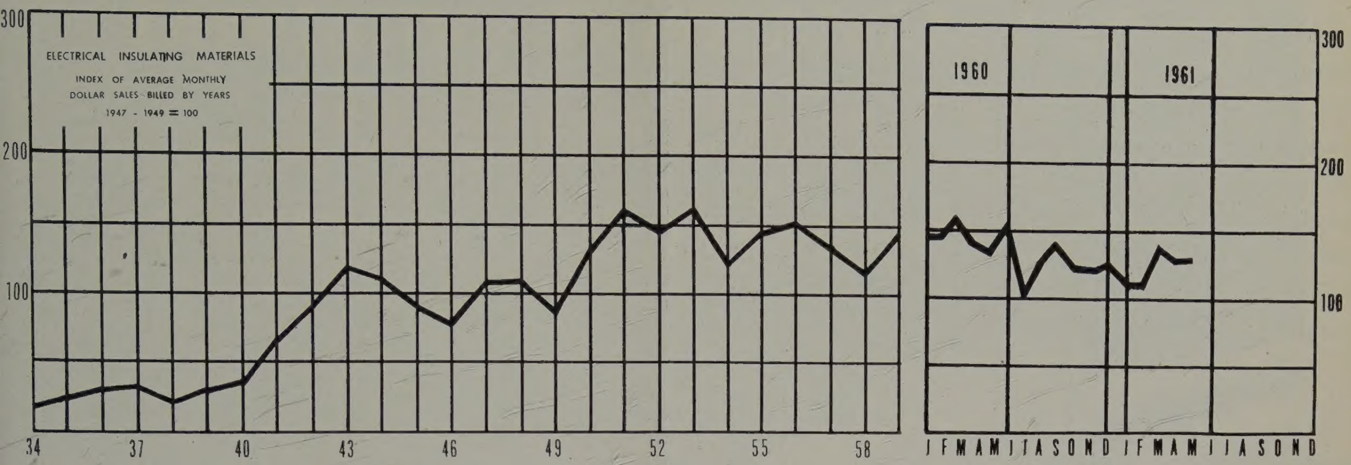
Nov. 16 . . . NEMA, Annual Meeting, Summit Hotel, New York City.

Dec. 12-14 . . . Eastern Joint Computer Conference, sponsored by AIEE, IRE, and Association of Computer Manufacturers, Sheraton-Park Hotel, Washington, D.C.

Abbreviations Used in Notices

AIEE	—American Institute of Electrical Engineers
ASTM	—American Society for Testing Materials
ASME	—American Society of Mechanical Engineers
ASA	—American Standards Assn.
IRE	—Institute of Radio Engineers
EIA	—Electronic Industries Assn.
NEMA	—National Electrical Manufacturers Assn.
EASA	—Electrical Apparatus Service Assn.
SPE	—Society of Plastics Engineers
SPI	—Society of the Plastics Industry
WEMA	—Western Electronic Manufacturers Assn.

NEMA Electrical Insulation Index



	May '61	Apr. '61	May '60
Index Series	129	125	134
May '61 point change from other mos.		+4	−5
May '61 % change from other months		+3	−4

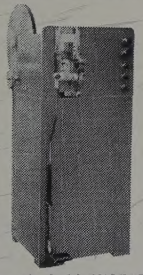
Index is based on 1947-1949 average month, inclusive=100

Published through the courtesy of the National Electrical Manufacturers Association

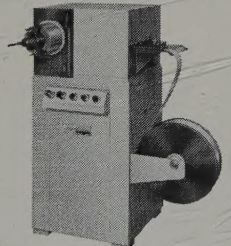
Materials Used in Electrical Insulation Index

- Industrial Laminated Products
- Manufactured Electrical Mica
- Flexible Electrical Insulation
- Vulcanized Fibre
- Coated Electrical Sleeving

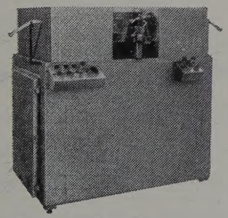
SAVE Operating Time
Operating Costs
Equipment Investment
with Automatic Machines by POSSIS



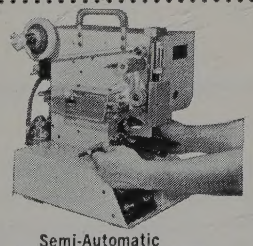
Automatic CELL INSERTER



Automatic STATOR CUFF INSERTER



Automatic
Double Flier ARMATURE WINDER



Semi-Automatic
Wire and Harness TAPER

Fully automatic machines save up to 50% of operating time on many production line jobs. Appreciable savings possible on many of your manufacturing operations. Write today for information; detailing *your* specific requirements!

POSSIS MACHINE CORPORATION
827 Rhode Island Ave. • Minneapolis 26, Minn.
Manufacturers of Cell and Wedge Inserters • Armature Winders • Coil Winders • Semi-Automatic Taping Machines • Automatic Fence Weaving Machines • Special Machines of the Electric Motor and Automotive Industries

Print Ins. 61 on Reader Service Card

Model BT-5-DR 5-Ton Double Ram Press
Model BD-3 3-Ton Deep Throat Press
Model BM-4 4-Ton Back Flywheel Press
Model BT-25-G 25-Ton Back Geared Press
Model BT-8 8-Ton Press
Model B-2-A 2-Ton Half Press
See Yellow Pages for Local Distributor

ALVA ALLEN
HEAVY DUTY PUNCH PRESSES

1 to 25 Ton Capacity Presses in Hundreds of Different Model Combinations

POWERFUL—DEPENDABLE FULLY GUARANTEED MODERATE IN PRICE

Including accessories — Motors and Controls, Dial Index Feeds, Air Clutch-Brake Units, Safety Equipment, Friction Roll Feeds, Punch and Die Units, etc.......

Thousands in Use the World Over

ALVA ALLEN INDUSTRIES, Dept. IS
Clinton, Missouri Tel. TUrner 5-3331

Print Ins. 62 on Reader Service Card

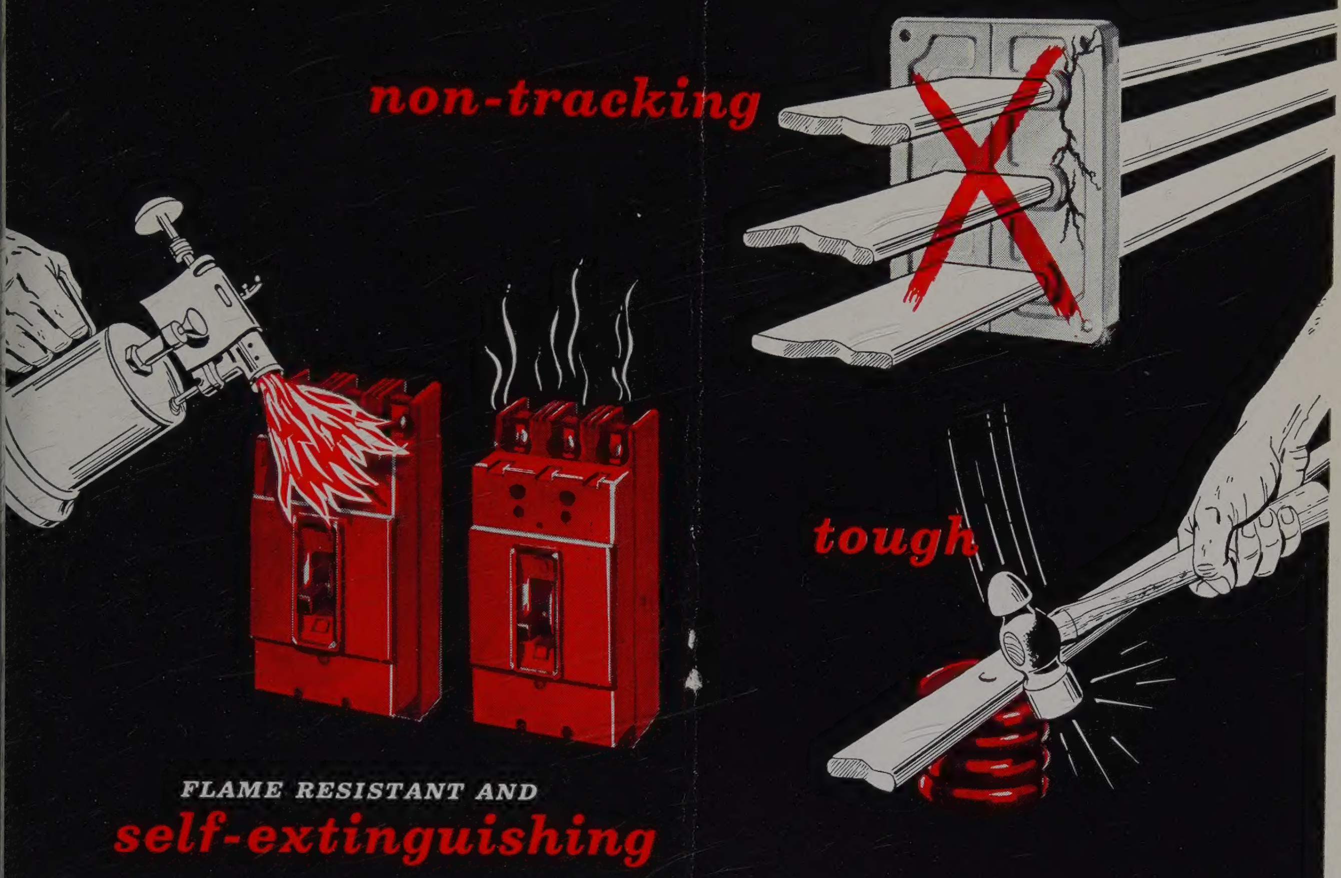
Advertisers' Index

To obtain more information on products of Insulation *advertisers, just print the advertisement number shown for each advertiser in one of the spaces on the Reader Service Inquiry Card on the inside back cover. This number appears under each advertisement and is also repeated in the listing below. After filling out the card completely, tear it off and drop it in the mail—no postage required.* Insulation *will promptly forward your requests for further information to the advertisers.*

Number	**Advertiser**	**Page**
Ins. 62	Alva Allen Industries	95
Ins. 64	Aluminum Co. of America, Rea Magnet Wire Co., Inc., Div.	Outside Back Cover
Ins. 9	American Enka Corp., Wm. Brand-Rex Div.	13
Ins. 20	Anaconda Wire & Cable Co.	45
	Belden Manufacturing Co.	15
Ins. 1	Bentley-Harris Manufacturing Co.	Inside Front Cover
Ins. 58 & 60	James G. Biddle Co.	91 & 93
Ins. 16	Catalytic Combustion Corp., A Subsidiary of Universal Oil Products Co.	32
Ins. 30	Chemical & Power Products, Inc.	58
Ins. 39	Ciba Products Corp.	71
Ins. 43	The Connecticut Hard Rubber Co.	77
Ins. 42	Crocker, Burbank Papers Inc.	76
Ins. 35	J. P. Devine Mfg. Co.	64
Ins. 31	John C. Dolph Co.	59
Ins. 8	Dow Corning Corp.	10 & 11
Ins. 17	E. I. du Pont de Nemours & Co. (Inc.) Film Dept.	41
Ins. 10	Emmco Plastics Corp.	14
Ins. 38	Enjay Chemical Co., A Division of Humble Oil & Refining Co.	69
Ins. 40	Essex Wire Corp., Magnet Wire Div.	73
Ins. 14	General Electric Co., Silicone Products Dept.	28
Ins. 63	The Glastic Corp.	Inside Back Cover
Ins. 52	J. J. Glenn and Co.	87
Ins. 57	Grieve-Hendry Co., Inc.	89
Ins. 49	Hull Corp.	84
Ins. 55	The Huse-Liberty Mica Co.	88
Ins. 3	Insulation Manufacturers Corp.	2
Ins. 37	Johns-Manville, Dutch Brand Div.	66 & 67
Ins. 22	L. Frank Markel & Sons	48
Ins. 36	Lake Publishing Corp.	65
Ins. 32	Midwest Molding & Manufacturing Co.	60
Ins. 48	Mitchell-Rand Manufacturing Corp.	84
Ins. 29	Molecular Dielectrics Inc.	57
Ins. 13	National Vulcanized Fibre Co.	27
Ins. 27	Natvar Corp.	55
Ins. 53	Newbury Industries, Inc.	87
Ins. 6	New Jersey Wood Finishing Co.	7
Ins. 51	Norton Co., Refractories Div.	85
Ins. 24	Phelps Dodge Copper Products Corp., Inca Manufacturing Div.	50 & 51
Ins. 25	Plymouth Rubber Co., Inc.	53
Ins. 33	Polymer Processes Inc., A Subsidiary of the Polymer Corp.	61
Ins. 61	Possis Machine Corp.	95
Ins. 54	Precision Paper Tube Co.	88
Ins. 2	Prehler Electrical Insulation Co.	1
Ins. 47	Raybestos-Manhattan, Inc., Plastic Products Div.	83
Ins. 5	Rayclad Tubes Inc., A Subsidiary of Raychem Corp.	5
Ins. 34	The Richardson Co.	63
Ins. 28	Riegel Paper Corp.	56
Ins. 46	Rohde & Schwartz	82
Ins. 19	Rubber & Asbestos Corp.	43
Ins. 26	Sames Corp.	54
Ins. 12	Shawinigan Resins Corp.	16
Ins. 7	Spaulding Fibre Co., Inc.	9
Ins. 56	Star Porcelain Co.	89
Ins. 23	J. P. Stevens & Co., Inc.	49
Ins. 41	Sylvania Electric Products Inc., Parts Div.	75
Ins. 45	Taylor Fibre Co.	80 & 81
Ins. 44	Union Carbide Corp., Silicones Div.	79
Ins. 21	Union Carbide Corp., Union Carbide Plastics Co., Div.	47
Ins. 15	Varflex Sales Co., Inc.	31
Ins. 59	Western Sky Industries	91
Ins. 18	West Virginia Pulp & Paper Co.	42

Advertising Sales Offices:
Libertyville, Ill.—(General Offices P.O. Box 270, 311 E. Park Ave. Phone EMpire 2-8711 (Area Code 312)
Chicago 11, Ill.—Philip Holmes, Robert D. Foran, and Tom Fitzpatrick. 410 N. Michigan Ave. Phone 467-6240
Detroit 26, Mich.—Charles R. Schroeder
413 Lafayette Bldg. Phone WOodward 1-0278
New York 20, N.Y.—Robert Bandini and Roland Robitaille
1 Rockefeller Plaza. Phone CIrcle 6-4712
Pacific Coast—H. L. Mitchell & Assoc., 1450 Lorain Road, San Marino, Calif. Phone CUmberland 3-4394
Northern California only—James T. Stevenson, 420 Market St., San Francisco 11, Calif. Phone YUkon 1-3575

Insulating Parts Molded of **RESISTRAC**® *Premix Compound:*



Unique! RESISTRAC molding compounds possess a heretofore unobtainable combination of properties: High track resistance plus arc-suppressing action. Flame resistance and self-extinguishing within 30 seconds after flame source is removed. Toughness due to fiber glass reinforcement. Close dimensional control in the molded part plus dimensional stability under service conditions.

Costs for parts molded of RESISTRAC are competitive with those for conventional reinforced plastic. And full design utilization of RESISTRAC's properties could lead to higher apparatus ratings.

RESISTRAC may be evaluated in your present molds. Please outline your requirements; we'll promptly supply technical data and appropriate trial molding samples.

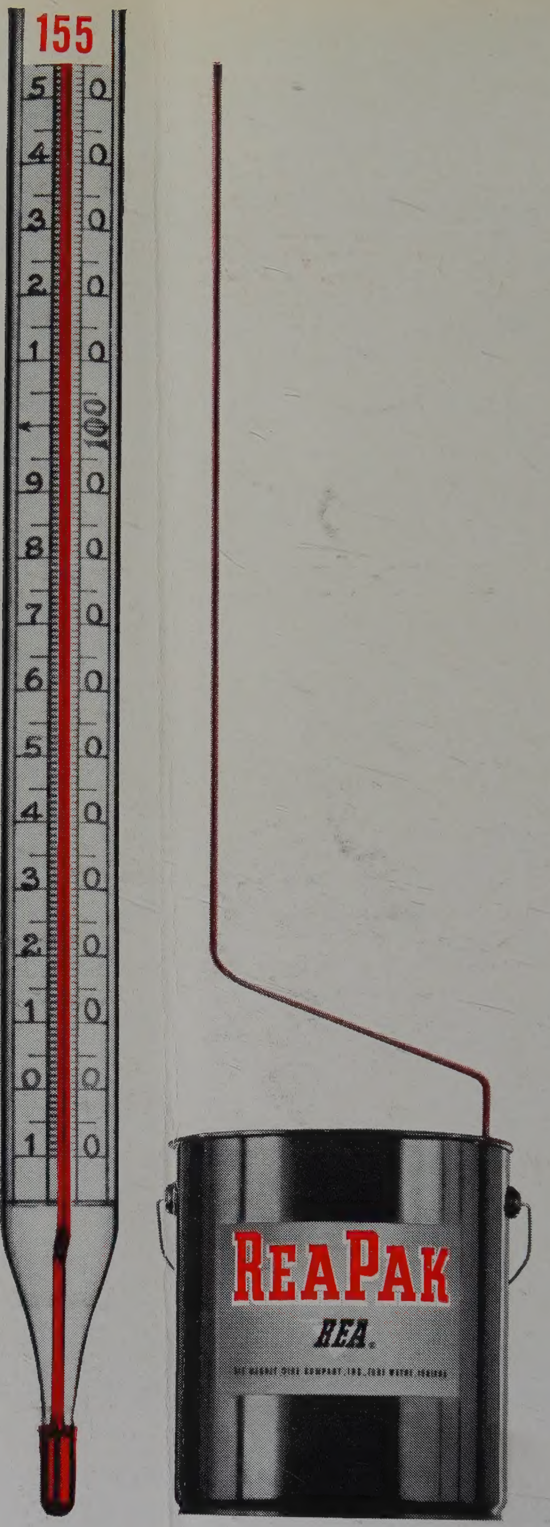
Exclusive

Glastic RESISTRAC molding compound is the only alumina-filled compound available carrying with it license to apply as covered in U. S. Patent 2,768,264.

THE GLASTIC® CORPORATION

Glenridge at Green • Cleveland 21, Ohio

Print Ins. 63 on Reader Service Card



Ask your Rea man about versatile Poly-Thermaleze...for 155°C operatio

He'll describe an improved polyester magnet wire that offers increased resistance to abrasion, solvents and heat shock . . . while retaining vital moisture resistance characteristics. Rea Poly-Thermaleze* is a Class F (155°C) polyester-film, insulated wire available at the cost of standard Class A (105°C) magnet wires. Thus, it is applicable to either Class A (105°C), Class B (130°C) or Class F (155°C) electrical apparatus. Rea Poly-Thermaleze embodies an unusually good combination of physical, chemical, thermal and electrical characteristics. And it's available in the famous ReaPak® container or standard spools and reels. Call your Rea man today—or write to us in Fort Wayne for samples and more information.

*Licensed by Phelps-Dodge Copper Products Corp.

REA

Copper and
Aluminum Magnet Wire,
All Insulations

REA MAGNET WIRE COMPANY, INC. • *Division of Aluminum Company of America* • Dept. 1930-J, Fort Wayne, Indiana • TWX: FW

Print Ins. 64 on Reader Service Card